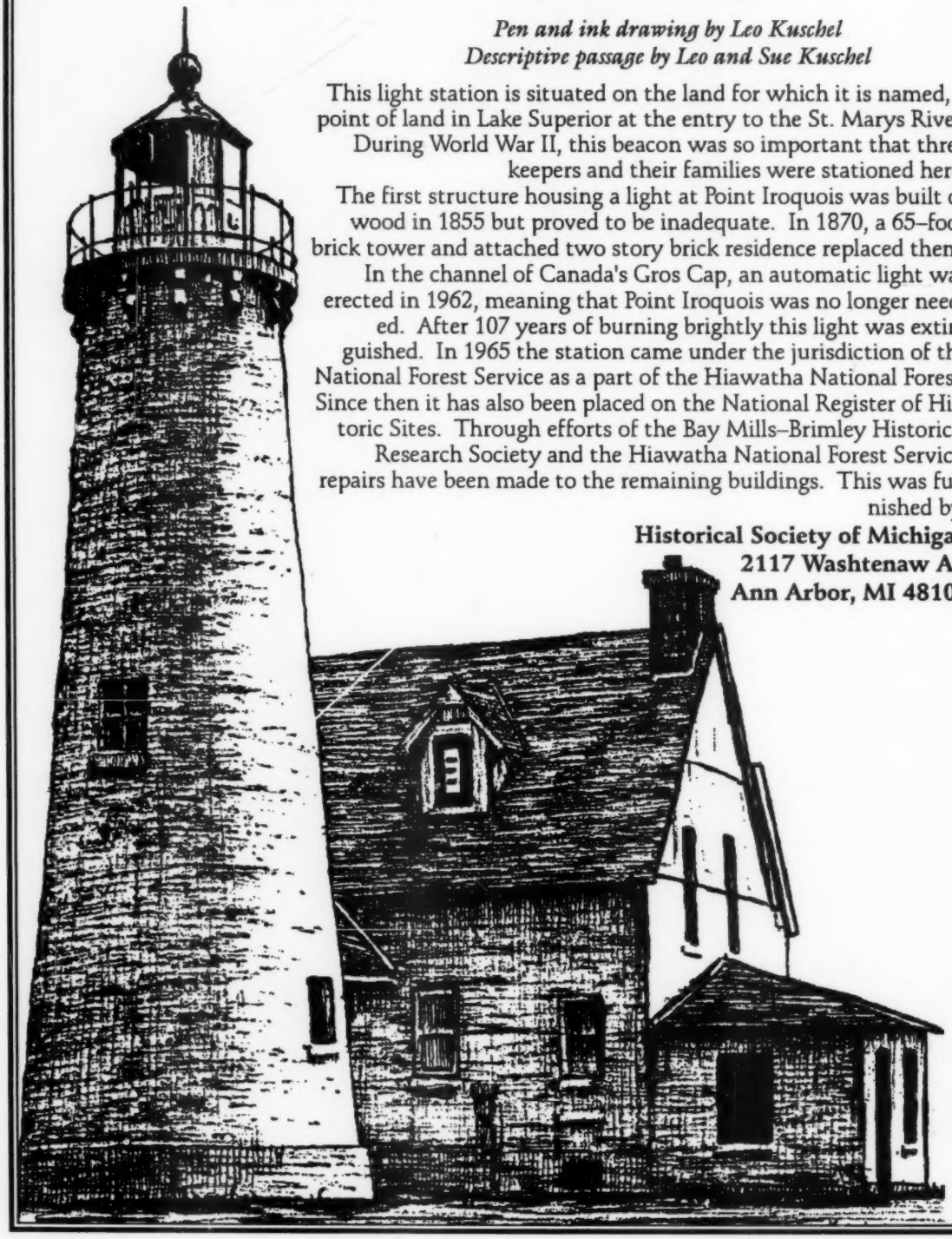
Mariners Weather Log

Fall 1990 Vol. 34, No. 4

Point Iroquois Lighthouse

Lake Superior, Michigan

Pen and ink drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel



This light station is situated on the land for which it is named, a point of land in Lake Superior at the entry to the St. Marys River. During World War II, this beacon was so important that three keepers and their families were stationed here. The first structure housing a light at Point Iroquois was built of wood in 1855 but proved to be inadequate. In 1870, a 65–foot brick tower and attached two story brick residence replaced them. In the channel of Canada's Gros Cap, an automatic light was erected in 1962, meaning that Point Iroquois was no longer needed. After 107 years of burning brightly this light was extinguished. In 1965 the station came under the jurisdiction of the National Forest Service as a part of the Hiawatha National Forest. Since then it has also been placed on the National Register of Historic Sites. Through efforts of the Bay Mills–Brimley Historical Research Society and the Hiawatha National Forest Service, repairs have been made to the remaining buildings. This was furnished by:

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Vol. 34, No. 4 October, November and December 1990

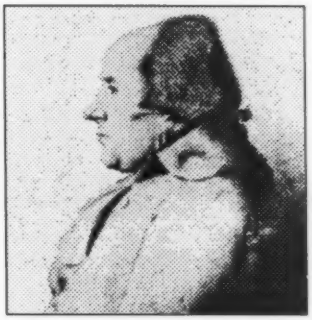
Features

2
Who Put the Wind Speeds in Admiral Beaufort's Force Scale?
Dr. Blair Kinsman
Part 1— the original scale.

10
Bombs Over the North Atlantic
Bud Dorr
A first hand account of two flights for project ERICA.

16
The Incredible Voyage of William Bligh

*Sometimes lost in the tale of the mutiny of the **Bounty** is a voyage that defied the odds.*



page 16

page 22

Departments

22 Whale Oil and Wicks
Elinor DeWire

25 Mailbag

26 PMO Report

32 Ocean Queries
Rosa T. Washington

34 Marine Observation Program
Martin S. Baron

39 Sea Photography

40 Radio Officer Tips

46 Editor's Desk

49 Hurricane Alley

Marine Weather Review

51 North Atlantic Ocean
April, May and June 1990

56 North Pacific Ocean
April, May and June 1990

62 Track Charts
April, May and June 1990

68 Tables
April, May and June 1990

Editor: Richard M. DeAngelis

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Cover: High seas generated by Hurricane Bertha pound the ill-fated ***Corazon***, some 300 mi southeast of Cape Cod. Twenty-one crew members were rescued. Story on page 46. U.S. Coast Guard photo by AE1 Keith D. Rauch

Back Cover: The 200th anniversary celebration of the U.S. Coast Guard continues. Built in New York in 1819, the ***Louisiana*** spent her entire service at New Orleans. In the 1820's the Caribbean Sea and the Gulf of Mexico were notorious as the domains of pirates. Along with her sister ship the ***Alabama***, the ***Louisiana*** was responsible of the capture of at least a dozen pirate vessels. The drawings are based upon the research of the famous historian Howard I. Chapelle.

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July 1, 1991.

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Beaufort took command of ***Woolich***, a frigate armed en˙ flute. It was at this time that Beaufort devised his wind force scale, although you can find other dates in the literature. Admiral Robert FitzRoy, Beaufort's protege as a young officer, says in his *Weather Book, A Manual of Practical Meteorology*: *"All honor to Beaufort, who used and introduced this succinct method of approximation by scale... By the kindness of his family, we have them now before us, in the log of* ***H.M.S. Woolwich*** *in his own hand–writing dated 1805."*

As they rowed back to the ship, a sniper put a ball through Captain Beaufort's groin...

I have a mental picture of Beaufort glowering at the latest crop of inept young middies, dashing off his scale on the back of an old envelope, nailing it to the bulkhead, and growling: *"There! Even if they can't tell the difference between a gale and an Irish hurricane they can at least count the sails on their fingers."*

Between 1805 and 1810 when he was promoted to post rank (captain or higher), Beaufort commanded a number of ships and served from the East Indies to Quebec. When not otherwise occupied he made hydrographic surveys; his data made possible new and accurate charts of the entrances to the Rio de la Plata.

From 1811 to 1812 Captain Beaufort commanded the ***H.M.S. Frederiksteen***, 32, in the eastern Mediterranean, engaged in a hydrographic survey of the coast of Asia Minor. With his left hand he suppressed the organized system of general and absolute piracy prevalent there, and pursuing another hobby, made astronomical observations which abruptly ended the survey. In June 1812, Beaufort had an astronomical party ashore when an armed skirmish broke out among the local pashas. Beaufort himself went in to take his shore party off. As they rowed back to the ship, a sniper put a ball through Captain Beaufort's groin, breaking his hip. Beaufort was gotten safely back to Malta but did not recover for months. The survey had been interrupted and the ***Frederiksteen***, too long in service, was in almost as bad shape as her captain. Both were ordered home at the end of 1812.

In addition to his wind force scale, he devised a widely used system for coding weather observations.

Beaufort spent the next few years working up the data from his survey and constructing charts for the coast of Asia Minor. Marshall, contemporary biographer of the Royal Navy, comments: *"From the weighty responsibility attached to such a work, he considered it necessary that the whole should be executed by his own hand; and we have reason to believe...that previous to his doing so, no maritime surveyor ever lodged at the Admiralty, MSS [manuscripts] so drawn and arranged as to be fit for immediately placing on the copper [etching], without first deriving aid either from the Hydrographer or some of his assistants."*

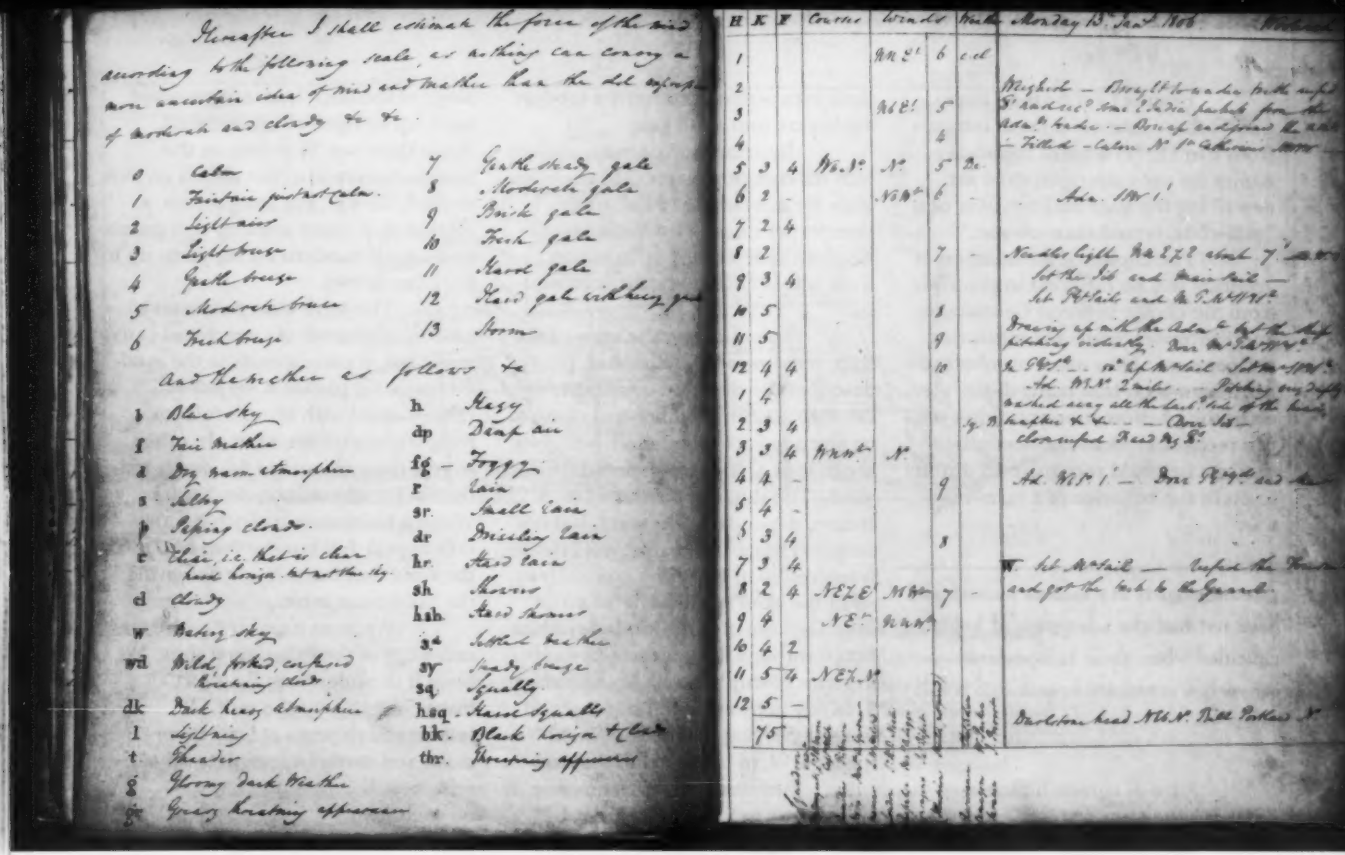
In 1817 Beaufort published a book, *Karamania, or a Brief Description of the South Coast of Asia–Minor, and of the Remains of Antiquity.* Quite characteristically, he refused to accept any payment since "the materials... were acquired in his Majesty's service in the execution of a public duty."

In 1829 he was appointed Hydrographer to the Admiralty, a post which he held for the next 26 years. In 1838 the Beaufort wind force scale became mandatory for log entries in all ships of the Royal Navy. In 1846 Beaufort was made rear–admiral and, in 1848, Knight Commander of the Bath in recognition of his civil services as Hydrographer. He died in 1857 two years after his retirement.

Figures to Denote the Force of the Wind

0 Calm		
1 Light Air	Or just sufficient to give steerage way.	
2 Light Breeze	Or that in which a man–of–war with all sail set, and clean full would go in smooth water from.	1 to 2 knots
3 Gentle Breeze		3 to 4 knots
4 Moderate Breeze		5 to 6 knots
5 Fresh Breeze	Or that to which a well–conditioned man–of–war could just carry in chase, full and by.	Royals, &c.
6 Strong Breeze		Single–reefed topsails and top–gal. sail
7 Moderate Gale		Double reefed topsails, jib, &c.
8 Fresh Gale		Treble–reefed topsails &c.
9 Strong Gale		Close–reefed topsails and courses.
10 Whole Gale	Or that with which she could scarcely bear close–reefed main–topsail and reefed fore–sail.	
11 Storm	Or that which would reduce her to storm staysails.	
12 Hurricane	Or that which no canvas could withstand.	

Here is the earliest version of the wind force scale I was able to find. It dates from 1831 and is included with Beaufort's memorandum to Fitzroy. [The earliest Beaufort's scale we could track down is on the following page. It appeared in his logbook and is dated January 13, 1806. It was provided to us by Derek Painting, Director of the Operational Instrumentation Branch, of Great Britain's Meteorological Office. Note that Beaufort originally considered the use of the scale from 0 to 13].



You won't read much of the scientific literature of the nineteenth century without gaining the impression that Admiral Beaufort was considered a scientist by contemporary scientists of substantial achievement. Sources suggest he had a hand in the invention of the cup anemometer. In addition to his wind force scale, he devised a widely used system for coding weather observations.

Most glaringly obvious about Beaufort's scale is that it is a force scale. Beaufort does not mention wind speed.

The admiral's advice to young Commander FitzRoy (captain of ***H.M.S. Beagle*** for the expedition during which the young Charles Darwin, supernumerary at FitzRoy's invitation, saw the Galapagos and stumbled on evolution) is so apt, even for the twentieth century, that I cannot resist a sample: *"Trifling as it may appear, the love of giving a multiplicity of new and unmeaning names tends to confuse our geographical knowledge. The name stamped upon a place by the first discoverer should be held sacred by the common consent of all nations; and in new discoveries it would be far more beneficial to make the name convey some idea of the nature of the place; or if it be inhabited, to adopt the native appellation, than to exhaust the catalogue of public characters or private friends at home. The officers and crews indeed, have some claim on such distinction, which slight as it is, helps to excite an interest in the voyages."*

In addition to outlining the Beagle's hydrographic survey Beaufort called for a world girdling line of meridian positions— the exact longitude of even such long frequented ports as Rio de Janeiro was still in doubt in 1831. He delineated observation programs in marine geology, physical oceanography, meteorology, magnetism, astronomy, and economic and cultural geography.

The admiral was a fellow of the Royal Society, London, vice president and fellow of the Royal Astronomical Society, fellow of the Royal Irish Academy, and a corresponding member both of the Institute of France and of the United States Naval Lyceum. Pleasant as it is to linger with him, we should get along to his wind force scale.

The earliest version that I have been able to find dates from 1831 and is included with Beaufort's memorandum to Commander FitzRoy. I think this an accurate statement of the original Beaufort scale. The versions common today often are not. Scientists are not usually familiar with ships under sail and may easily misread Beaufort's intentions.

Most glaringly obvious about Beaufort's scale is that it is a force scale. Beaufort does not mention wind speed. I think the omission was deliberate and that Beaufort felt that wind speed was irrelevant.

Beaufort's scale is an association of three lists: (1) a list of integers from 0 to 12; (2) a list of common names for wind strength; (3) a list describing the state and behavior of a "well–conditioned man–of–war."

The choice of the numbers is arbitrary and no different in principle from the choice between Centigrade and Fahrenheit scales for measuring temperature. How many numbers you use depends on how many distinct levels of the phenomenon you think you can recognize. Beaufort obviously thought he could recognize 13 distinct levels in the behavior of a man–of–war.

Meteorologists are seldom seamen and have not had the advantage of being ridiculed when their inexperience converts a moderate breeze into a full gale.

A list of common names describes the same states of wind to several observers only if they share common experience. What Chesapeake Bay yachtsmen call a *heavy blow* will be a *moderate breeze* to visiting yachtsmen from South Africa. The wind regimes on the Chesapeake Bay and on Table Bay and the characteristic sailing rigs are so different that the wind names used by the two groups have almost nothing in common.

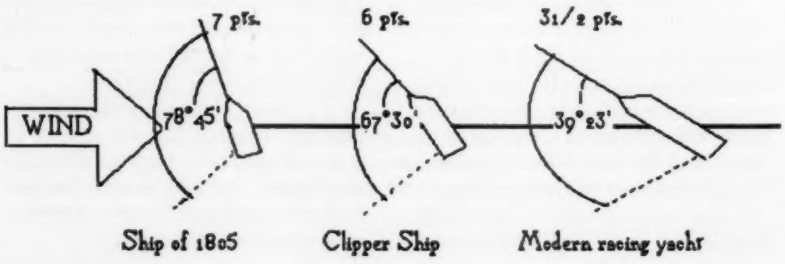
Today, failure to associate the same descriptive term with its corresponding wind speed is frequent when Beaufort numbers are used. Beaufort's force numbers belong to the seamen. Meteorologists are seldom seamen and have not had the advantage of being ridiculed when their inexperience converts a moderate breeze into a full gale.

Beaufort had no such trouble with his common terms. He made his scale for men who had shared the same experience— years of unremitting blockade of Europe in sailing ships whose characteristics were similar.

The third list, the **state of the ship**, is the meat of the matter. It describes the different conditions of the ship and the number and name to be given to each. And mark well, you are to look at the ship— not at the wind. The ship's appearance, of course, depends on the wind, but not simply. I suspect Beaufort was intensely interested in the ship and hardly at all in the wind speed. The 13 states described are of three kinds: for numbers 0 through 4 the descriptions are in terms of ship's speed; for 5 through 9, jointly in terms of her mission and her sail carrying ability; and for 10 through 12, in terms of her survival.

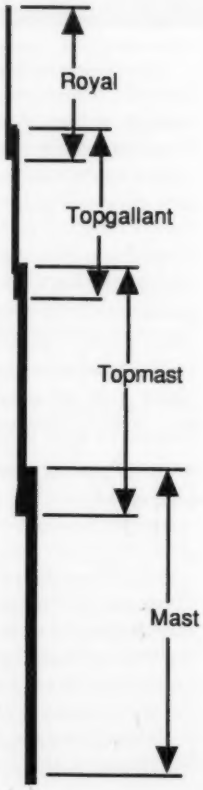
Beaufort's descriptions may seem vague to a modern reader but they certainly conveyed precise meaning to Nelson's captains. Let's see if we can understand them too.

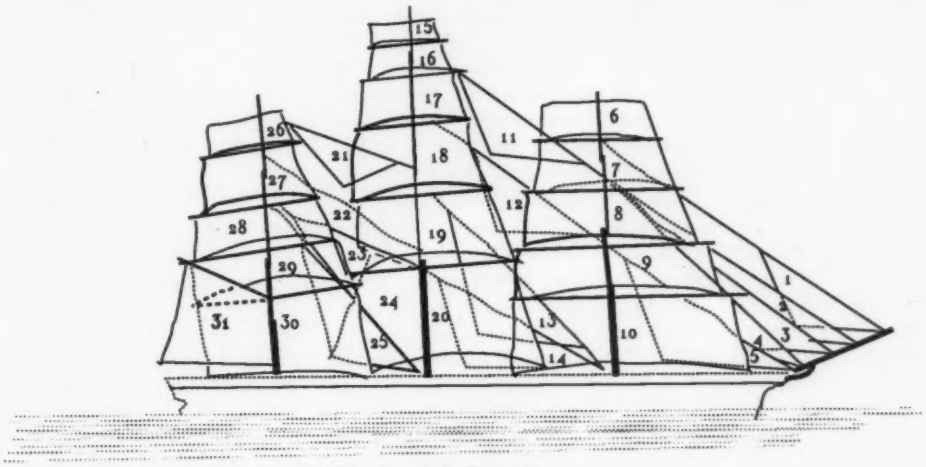
Beaufort numbers 2 through 4 and 5 through 9 correspond to *clean full* and *full and by* respectively, which describe the ship's angle to the wind. There is no trouble with *full and by*; one dictionary definition reads: *"sailing close–hauled on a wind, when a ship is as close as she will be to the wind without suffering the sails to shiver, hence keep her full and by is the order to the helmsman not to incline too much to windward and thereby shake the sails which would retard the ship's velocity."* No sailing vessel can move directly to windward but some are more weatherly than others. The ships of the Napoleonic Wars could work up to 7 points off the wind. Since there are 32 points on the mariner's compass, this means no closer than 78° 45'. For comparison, a clipper ship could work up to 6 points and a good modern racing yacht up to 3 1/2 [see below].



The term *clean full* seems to have disappeared. As nearly as I can make out, it corresponds to the modern yachting phrase *a rap full*— close–hauled with all sails full but lying slightly off the wind. In other words, *clean full* means *full and by* with the added admonition *don't pinch*. When a helmsman is pinching, the sails appear full but the ship is so near the wind that the sails are not giving the maximum drive.

We must turn now to the terminology of the full–rigged ship. We need it to understand Beaufort's instructions about the sails. A full–rigged ship has at least three masts and carries a complete set of square–sails on each. From bow to stern, the masts are the *fore mast*, the *main–mast* and the *mizzen–mast*. The order of decreasing height is usually the *main–mast, the fore mast* and the *mizzen–mast. The mast* is the unbroken spar which extends to the masthead. Historically, each successively higher section is an addition to *the* mast. Next is the *topmast*. Later the *topgallant– mast*





Sail Plan for a Fully Rigged Vessel

1. Flying–jib*
2. Outer–jib
3. Inner–jib
4. Fore–topmast–staysail
5. Fore–staysail*
6. Fore–royal
7. Fore–topgallant
8. Fore–upper–topsail**
9. Fore–lower_topsail**
10. Fore course
11. Main–royal–staysail
12. Main–topgallant–staysail
13. Main–topmast–staysail
14. Main–staysail
15. Main–skysail
16. Main–topgallant
18. Main–upper topsail**
19. Main–lower–topsail**
20. Main course
21. Mizzen–royal–staysail
22. Mizzen–topgallant–staysail
23. Mizzen–middle–staysail*
24. Main–spencer*
25. Mizzen–topmast–staysail
26. Mizzen–royal
27. Mizzen–topgallant
28. Mizzen–upper–topsail**
29. Mizzen–lower–topsail**
30. Cro'jack
31. Spanker

* It is probable that these sails would not be carried in Beaufort's time.

** The division of topsails into upper and lower came toward the middle of the 19th century in response to the rising wages of seamen. Sails divided into smaller areas can be worked by smaller crews. With the manning rates common to the Royal Navy during the Napoleonic Wars this was not a consideration and topsails were single large sails.

and the *royal–mast* were added.

Each square–sail is named by specifying first the mast and second the section within the mast to which it attaches. For example, in the accompanying sail plan above, **6** is the *fore–royal* while **27** is the *mizzen–topgallant.* If there are two square–sails on a single section, *upper* or *lower* precedes the name of the section. For spice, we have to have exceptions; while **10, 20** and **30** are the *fore, main* and *mizzen* sails, we usually call them the *fore course,* the *main course* and (the exception to the exception) the *cro'jack.*

The fore and aft sails carried on the stays that run between masts are named for the mast carrying the stay's higher point of attachment followed by the name of the section to which the stay attaches. To avoid confusion between the fore and aft sail and the square–sail carried on the same mast and section, add *staysail.* Thus, **22** is the *mizzen–topgallant– staysail.*

When the wind pipes up, the force it exerts on the sails increases and there always comes a time when a little less — of either wind or sail — seems desirable. Less sail is easier to arrange than less wind. You can bunch a sail up against the yard and tie it there — *furl* it. However, the jump all the way from *sail set* to *sail furled* is too big; you need a way to reduce sail in smaller steps. The device consists of horizontal rows of light line, called *reef points,* sewn to the sail.

In Beaufort's time, four rows of reef points were common on topsails. To reduce sail a little, seamen lay aloft, out on the footropes, drew the topmast row of reef points up to the yard, gathered the fold of sail above the row against the yard, and tied the reef points; the topsail was then *single–reefed.* If they tied in the second row, your sail would be *doubled–reefed;* if the third row, *treble–reefed.* With the last row you quit counting and settle for *close–reefed.* Now that we understand the terms, let's see if we can get the picture.

Beaufort Force 3: You are on the deck of the frigate H.M.S. *Woolwich* and she has *all sail set.* Spread on the yards and stays above are some 25 great, bellying expanses

of canvas— all she has. She is braced up hard on the wind but the helmsman has let her pay off just a little to get the best speed through the water (*clean full*). Small waves cover the sea; when the boatswain streams the log, it shows that the ship is making three to four knots; that's Beaufort 3. There's no doubt about it. All you have to do is look at the ship and how she goes. If you ask an old hand what the wind is, he'll call it a *gentle breeze.*

Beaufort Force 7: The seas are considerably higher and the ***Woolwich*** has become quite lively. You are *in chase* with the ***Droits D'Homme*** in sight to windward. Your captain is straining everything to work up and engage her. You are really hard on the wind, *full and by,* and the helmsman had better steer small and make every foot he can to weather unless he wants his back flogged bloody. The captain has judged his sails to hair's breadth. The courses are on her and so are her fore and aft sails. The *topsails* are set, but they have been *double–reefed.* The topgallants and royals are *furled.* From long experience the captain knows he can't show another square yard of canvas without blowing the sticks right out of her. So you thrash along and perhaps you come up with the ***Droits D'Homme,*** and perhaps you don't. Two things are sure: the captain is driving her for all she's worth and the wind is Beaufort 7. Your old hand calls it a **moderate gale.**

The seas are mountainous, and the motion on the *Woolwich* is something you'd rather be told about. The square sails are all furled.

Beaufort Force 11: The ***Droits D'Homme*** may be in sight, but you aren't paying her much attention. She isn't paying you much attention either. The seas are mountainous, and the motion on ***Woolwich*** is something you'd rather be told about. The square–sails are all *furled.* If someone has botched the job, the wind may pry into the wadded sail, rip it loose, and shred it to ribbons in seconds. Woolwich's ordinary staysails have been unbent and you are showing only a few small storm *staysails* of the heaviest canvas in an attempt to give the ship just enough motion through the water to keep some sort of control with the rudder. The wind force is Beaufort 11, and your old hand will tell you it's quite a **storm.**

Dr. Blair Kinsman

Blair Kinsman is best known for his book *Wind Waves,* but a real insight is provided by his widow Dorothy: *"Blair loved sailing and loved the sea. He was a true scholar, always going the extra mile (nautical mile) to track down all the information on a subject. As a teacher, which he considered his real profession, he brought out the best in his students, never losing faith in them, always generous with his time. In fact over the years, many people came to our house and asked for his help— not just oceanogarphy students, but high school students who were having trouble with their math and heard that he might be able to help them. Using his talent for making the complex seem simple, he never turned anyone away."*

Blair was born on December 21, 1914 in Philadelphia, PA. He spent his boyhood in Pennsylvania's mountains, but at the age of 13 he moved to Massachusetts, where he began to take an interest in salt water. Even a summer baiting trawl lines on Grand Manan, New Brunswick did nothing to discourage it. After receiving a S.B. in mathematics from the University of Chicago, he taught school for 9 years. During this time he learned to sail in waters off New England and on Lake Michigan. From 1947 to 1951 he taught at Saint John's College, Annapolis and sailed the Chesapeake Bay. In 1951 he joined the Chesapeake Bay Institute. Blair received an M.A. in oceanography in 1953 and a Ph.D. in 1960, both from Johns Hopkins. Since few were interested in the air–sea interface at that time and somebody had to cover it, waves became his field. *Wind Waves* was published in 1956. His activities at Johns Hopkins and the Chesapeake Bay Institute included mathematics consultant, technical editor, head of the data processing group, and head of the graphics arts section. He also taught graduate courses in Waves,Tides, Oceanic Turbulence, and Statistical and Mathematical Techniques in Oceanography. He found time to teach several undergraduate courses as well. In 1970–71 he was a Professor of Oceanography at the University of Delaware and was a Visiting Professor at the U.S. Naval Academy in 1974–75. As if all this was not enough Dr. Kinsman formed Blair Kinsman & Associates a consulting firm in 1973. During the next 16 years he did consulting work for such diverse organizations as Westinghouse, the Environmental Protection Agency, The State University of New York at Stony Brook, and Raytheon among many others. He belonged to the American Geophysical Union, American Association for the Advancement of Science, United States Naval Institue, Society for Nautical Research, Statistical Society of America and a number of other organizations. He published numerous articles on waves, tides and statistics. Several of his works appear in the McGraw–Hill Encyclopedia of Science and Technology and several have been translated into Russian and Japanese.

Dr. Kinsman was also a philospher. His outlook on science was summed up nicely in a passage in the preface of his book *Wind Waves* (Prentice Hall): "Science comes in two varieties, private and public. For myself, I find the private kind much more illuminating. It includes the jumps and hesitations by which the scientist has reached an idea. It gives some accounts of the false starts— why they seemed attractive at first, and what went wrong with them in the end. It doesn't omit the bugs in the instruments and the plans disrupted by storms. In short it portrays recognizable human minds at work— not a monolithic facade of established results."

When it's done holding your ship's garbage, it could hold death for some marine animals.

This plastic trash bag may not look like a jellyfish to you. But to a hungry sea turtle, it might. And when the turtle swallows an empty bag, the mistake becomes fatal.

The problem is more than bags. Plastic six-pack holders sometimes become lodged around the necks and bills of pelicans and other seabirds, ultimately strangling or starving them. Other plastic refuse, either through ingestion or entanglement, causes the deaths of thousands of seals, whales, dolphins and other marine mammals every year.

Plastic debris also causes costly and potentially hazardous delays to shipping when it fouls propellers or clogs intake ports.

It's a critical issue, destined to attract public and government scrutiny if we fail to take action to solve it.

So please, stow your trash, and alert your shipping terminals that you will need proper disposal on land. A sea turtle may not know any better. But now, you do!

To learn more about how you can help, write: Center for Marine Conservation, 1725 De Sales Street, N.W., Suite 500, Washington, D.C. 20036.

A public service message from:
The Center for Marine Conservation
The Natural Oceanic and Atmospheric Administration
The Society of the Plastics Industry

Bombs Over the North Atlantic

Bud Dorr

The Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) was designed to determine the causes of explosively deepening extratropical winter storms. This story describes two of the five ERICA missions from the winter of 1988–89.

Bud Dorr was a lead forecaster National Weather Service Forecast Office in Boston and was the Assistant Air Mission Scientist on three Erica flights. He now works in the Regional Office in New York.

This article originally appeared in the April 1990* Weatherwise *Vol. 43, No. 2

My excitement mounted as I drove the Maine Turnpike towards the Brunswick Naval Air Station to meet the rest of the ERICA field crew. This was real science! Now I would get to see one of these big storms up close, after 17 years of trying to forecast them at the Boston forecast office. As exit after exit breezed by, I thought about some of the great "bombs" of the past and their individual idiosyncrasies. A bomb is an extratropical cyclone whose central pressure falls at an average of a least one millibar per hour for 24 hours; I tried to imagine what it was going to be like to fly into one of them.

I parked my car and headed toward the door with the ERICA sticker on it. Inside, I made my way around a giant aircraft covered with dozens of busy maintenance workers. The stairway I wanted was just ahead and I clanked up to the second floor. Topping the stairs, I turned left and approached the open doorway at the end of the corridor. Voices drifting my way intoned familiar words "...strong positive vorticity advection... rapid intensification..." I could feel the excitement building.

Kathy Nuss, ERICA communications coordinator and organizer supreme, was trying to determine who was where. Did Walter have motel reservations? Who was going to get sandwiches? We needed a cloud physicist for Flight #3. Could someone go over to the Naval weather office and get the latest forecast charts and satellite pictures?

Dr. Wendell Nuss of the Naval Postgraduate School, Kathy's husband, was organizing his scientific team for that afternoon's flight. He introduced me to Bob Cohen, who showed me a Toshiba laptop computer I was to take onboard. This amazing machine was to store more than 20 atmospheric measurements, updated every second, for the entire flight. It was backup to onboard systems that would collect the same data.

Our team consisted of the mission scientist (Wendell), the assistant mission scientist (me), a cloud physicist (Walter Strapp), a dropsonde (an instrument dropped by parachute to sound the atmosphere) specialist (Ken Norris), and a radar specialist (Arthur Bourland).

Above Barry Damiano sits at the Flight Director's console in the Orion P–3. The Orion (left) has long been a workhorse for the National Weather Service. It has been used as a hurricane hunter and in severe storm and weather modification research. Jeff Masters

The ready–room team briefing was conducted by Dr. Carl Kreitzberg, chief of ERICA field operations at Brunswick. He asked me the present locations of National Weather Service stationary buoys, and told me to pick seven other locations where dropping additional buoys would maximize our mission data collection.

After all parties were heard from we worked together to finalize the flight track. This proved a very tricky and complicated endeavor. Restricted airspace, fuel and airspeed requirements, and the forecast storm track and intensity were among many factors to be considered— not to mention the scientific requirements of the flight.

The weather system we were tracking was a polar low now off the Delmarva Peninsula. It was expected to move northeastward to south of Sable Island and deepen into a bomb. The source of the necessary warm advection was expected to be the Gulf Stream. We wanted to learn as much as possible about the warm frontal structure of the system and to get an idea of how this particular storm was put together in the lower levels.

As we made our way toward the P–3 Orion hurricane–hunter aircraft, I noticed a group of stickers on the fuselage up front. Each bore a name, and one name, Gilbert, brought instant recognition. Each time this venerable aircraft had penetrated a named tropical storm, a sticker had been added to the fuselage. This baby had flown Gilbert, the most intense hurricane in this part of the world for as long as we have reliable records! My most fervent boyhood wish—which had been printed under my seventh–grade year–book picture—was to fly into the eye of a hurricane. That I was flying into a bomb instead of a hurricane really didn't seem to make that much difference. My dream was about to come true!

I went up the narrow entryway and into the plane. Equipment was everywhere. Dials, toggle switches, tubes, you name it. My work station was a large table in front of two chairs that faced down the aisle and allowed me to look directly into the cockpit. On the same side (the right side) and separated by about eight feet of open space, was the large bank of dropsonde instruments, with a single chair stationed in front of that panel array. Further down and on the left was the

Jeff Masters

Electronic Technichan Salim Leyva launches a dropsonde into the atmoshpere. This probe descends by parachute and radios back height, temperature and dewpoint readings.

onboard radar station. And in the cockpit, at the jumpseat station in back of the pilot's seat, was Wendell's work station.

The kitchen area, where coffee and sodas were stored, was behind me. Also in the kitchen was a printer that every 10 seconds printed out a sample of the 20 or so parameters being monitored during the flight. These same measurements were being stored in the Toshiba.

I was very glad I had dressed in long johns and layered clothing covered by a heavy down coat. Wool socks and heavy winter boots covered my feet. Even so, it felt cold— not surprising, since there was no heat yet and the outside temperature was only 15°F. I stored my four peanut butter and jelly sandwiches, bag of corn chips, four cans of pop, and a package of cookies under the seat next to me. I also remembered to take an air sickness tablet.

Wendell and I tested the onboard communications system. This would enable us to make on–the–spot observations, relay them to one another and change our flight plan in midair. Talk about seat–of–the–pants flying!.

The flight crew scurried around the aircraft for half–an–hour and several men of knowledge arrived and departed. Obviously, there was a problem of some sort. Finally, after almost two hours, we buttoned up the hatches and taxied down the runway. We had received a complete safety briefing by the head of the flight crew upon boarding, and there was no stewardess to tell us we were taking off. A terse announcement to put on our seatbelts came over the speaker and within a minute we were airborne.

I quickly discovered I was in a fairly cold part of the aircraft, the coldest being the tail and the warmest the cockpit. Once again, I blessed my long johns and down coat. Walter Strapp, the cloud physicist, had helped me link the Toshiba with the aircraft's observational system and it was humming away. I took the time to study the screen. There were about 15 displays available. Number 11 was the one–second update of more than 20 parameters, including filtered vertical winds and estimated surface pressure. Other displays included the radar screen and a graph of outside air temperature for the previous half–hour or so. I quickly realized that I would need to prioritize to use this system efficiently in real–time.

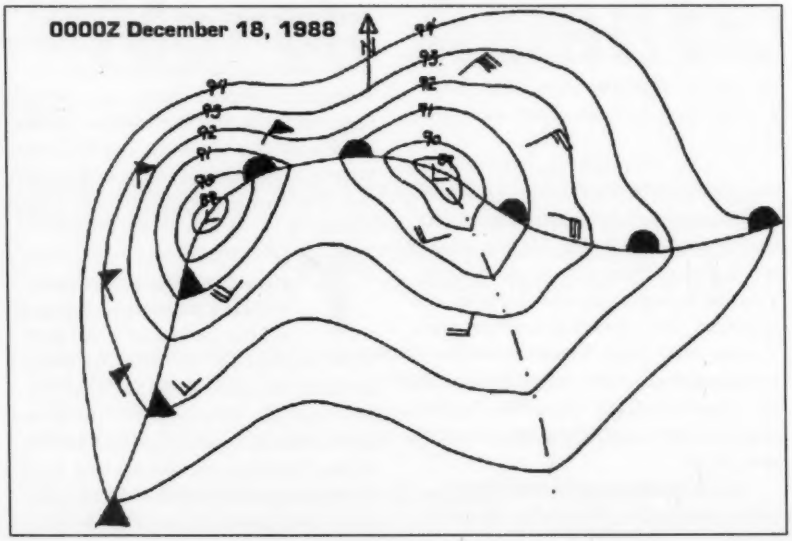
As I watched with keen interest, the dropsonde operator deployed the first of about a dozen instruments. After the sonde splashed into the frigid North Atlantic, the signal died and the operator gave me the printout of the run to plot and study.

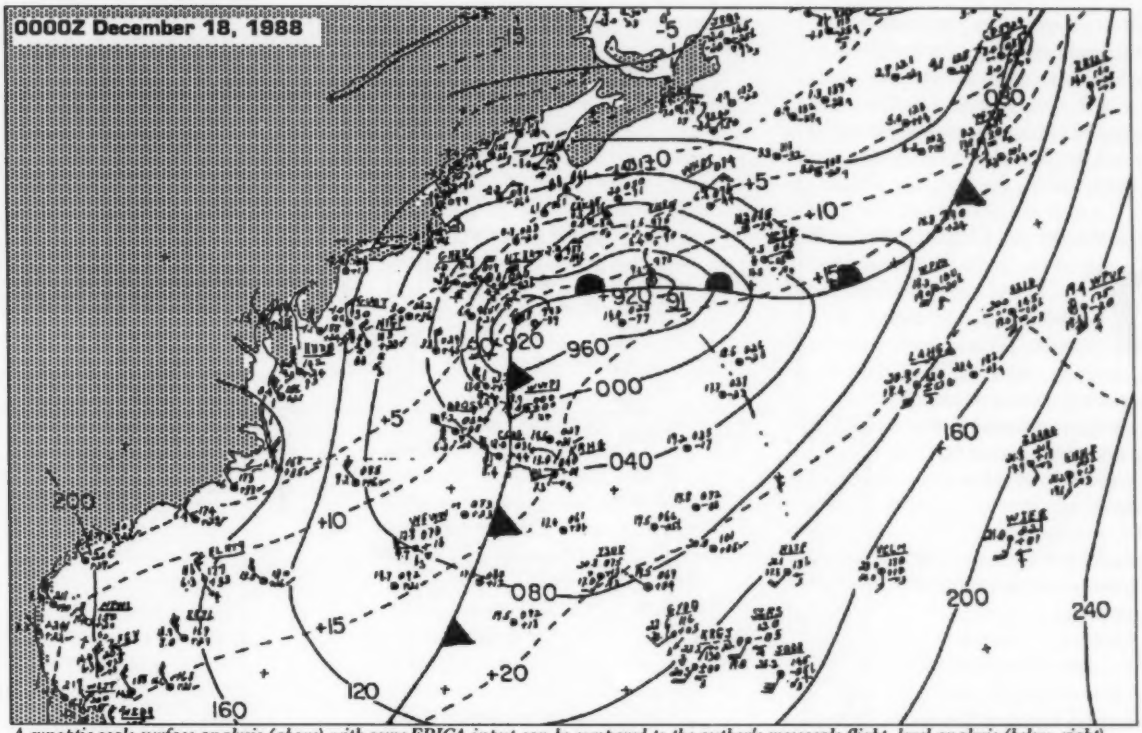
We planned to head east ahead of the developing low, then south to cross the expected warm front, then west or northwest to find the surface center. We flew at 18,000 feet; a lower altitude would not have enabled us to drop the sondes. On the way, we deployed buoys at the extra locations I had picked earlier.

As we headed south toward the warm front, the clouds thickened and closed in around us. Two hours passed and we began to get some light turbulence. Then we began our descent. As we plowed through the moisture–laden air, a sound like thousands of ball bearings hitting metal filled the plane. A query on the headset brought the answer–sleet!

The turbulence increased and became a problem when walking or writing. The pilot told us to fasten our seatbelts.

At an altitude of 1000 feet, northeast winds were whistling 45 to 60 knots and there was steady light–to–moderate turbulence.





A synoptic scale surface analysis (above) with some ERICA input can be compared to the author's mesoscale flight-level analysis (below, right). Note the deeper centers and stronger winds in the latter, as well as the tight pressure gradient north and west of the main center. The analysis above was done by Frederick Sanders with fronts drawn by author. Mesoscale is smaller, and more detailed than the synoptic weather maps.

Temperatures were close to freezing. Shortly thereafter the winds decreased and veered gradually to southeast as the temperature rose several degrees. Then, in less than 30 seconds, the wind veered to southwest and increased to 40 to 50 knots and the temperatures rose to about 14°C (57°F). "Warm front," I said over the headset. "Yes," agreed Wendell. Unfortunately, it was pitch black outside and we couldn't see anything.

We now headed northwest toward the low center. The clouds closed in again and the wind backed to southeast, then northeast and the temperature fell. Radar and other observations indicated we had overflown the center just to our south, so we headed southeast, hoping to come in behind it. The winds were north to north-northwest at 60 knots and the turbulence increased tremendously as we neared the center.

The pounding was incessant. My head was bouncing up and down so much I had to struggle to read the CRT screen right in front of me. Even though I was able to steady my head on occasion, my eyeballs kept bouncing up and down, preventing me from reading the data!

We criss-crossed the center several times in the next few hours and I began to realize something very odd. The center was only a few miles across at the most— and it was neatly tucked up tight against the polar air-mass banked along its north and west sides.

The central pressure was about 986 millibars, 10 to 15 millibars lower than we expected. In the dense polar air only 20 or 30 miles away to the northwest the pressure rose tremendously to about 997 millibars! There were no pressure gradients nearly as intense observed at any other locations relative to the storm center. The other surprising thing was that we were never able to record a calm wind, despite our criss-crossings.

Flying back to Brunswick I reflected in wonder on what we had seen. The simultaneous superpositioning of several scales of storm evolution was obvious. The mesoscale is seldom shown on a working weather map. Maps showing low centers 50 to 100 miles across, even for the most intense storms, are standard. This grossness completely ignores the mesoscale structure of the system— in this case, the intense, polar-side pressure gradient and the intense, but tiny low pressure center only a few miles in diameter. It would seem that ignoring this intense mesoscale circulation—the very heart of the storm system—must have a deleterious effect on our models' ability to forecast the future intensity and structure of such storms. Now I knew why the models never seem to deepen most Atlantic cyclones enough.

Although we had taken quite a physical beating from the turbulence and the long hours in the air, we were elated the mission had gone so well. I had a feeling of tremendous satisfaction when I finally rolled into bed around 2 a.m.

Birth of an Ultrabomb

Two weeks later, as I was sitting down to dinner at my fiancee's house, the phone rang. It was Carl Kreitzberg calling to ask if I would be interested in flying another mission. Of course I told him I was rarin' to go!

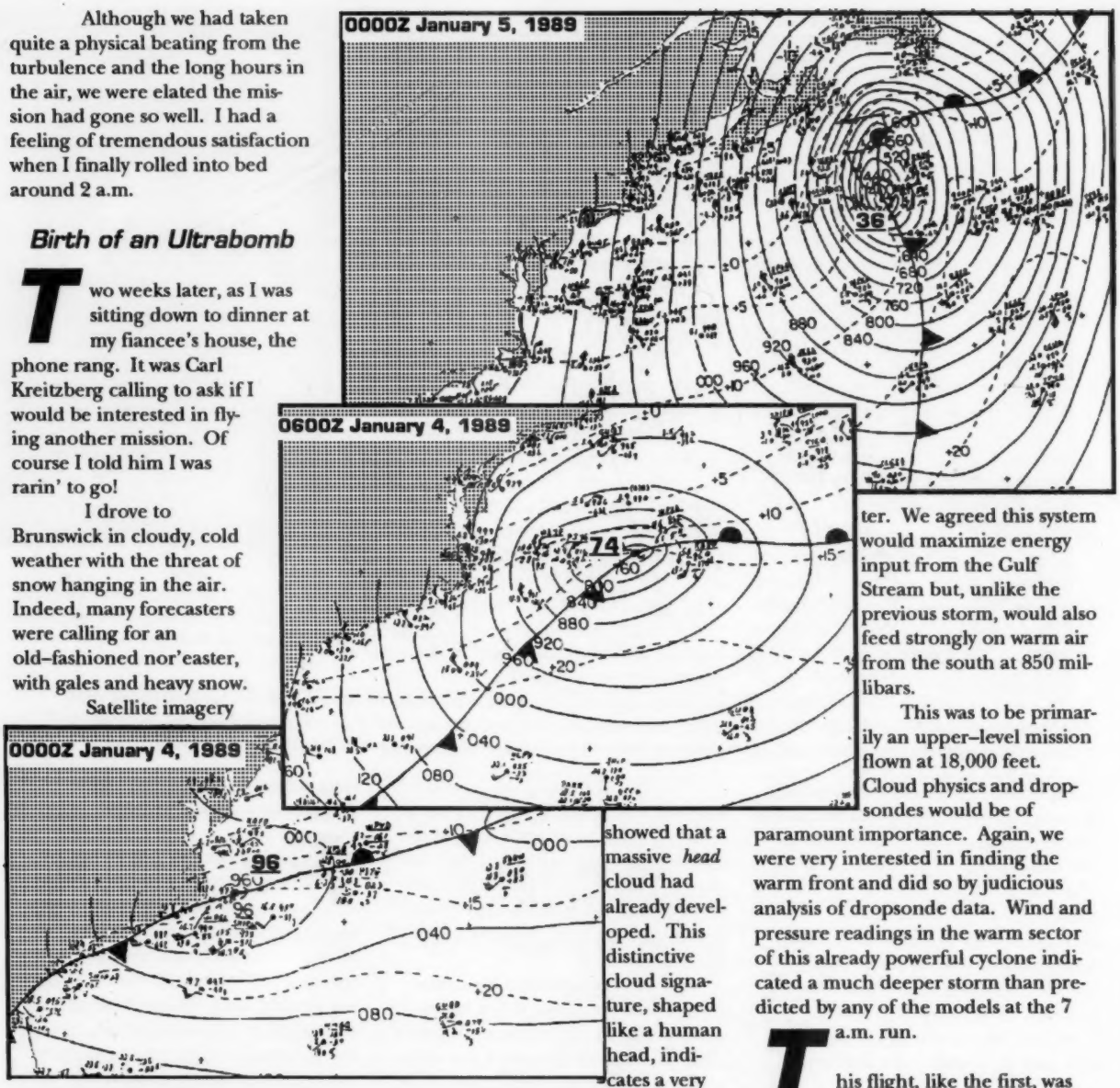
I drove to Brunswick in cloudy, cold weather with the threat of snow hanging in the air. Indeed, many forecasters were calling for an old–fashioned nor'easter, with gales and heavy snow.

Satellite imagery showed that a massive *head* cloud had already developed. This distinctive cloud signature, shaped like a human head, indicates a very intense system. I was expecting to observe the *instant* generation of an occluded front, a phenomenon associated with the formation of a head cloud.

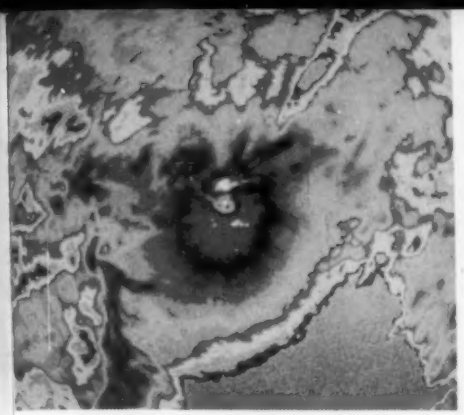
Meanwhile, surface development appeared to be occurring much farther south than forecast, based on my quickly analyzed 1 p.m. surface map. My advice to Carl Kreitzberg, the mission scientist, was to expect a very long flight to the east of Cape Hatteras if we wanted to reach the center. We agreed this system would maximize energy input from the Gulf Stream but, unlike the previous storm, would also feed strongly on warm air from the south at 850 millibars.

This was to be primarily an upper–level mission flown at 18,000 feet. Cloud physics and dropsondes would be of paramount importance. Again, we were very interested in finding the warm front and did so by judicious analysis of dropsonde data. Wind and pressure readings in the warm sector of this already powerful cyclone indicated a much deeper storm than predicted by any of the models at the 7 a.m. run.

This flight, like the first, was flown in darkness— which provided an unexpected thrill for those of us into intense convection. As we flew along the cold front in the warm sector, I began to notice bright flashes through the aircraft window. I cupped my hands to the sides of my head to block out interior lighting and peered out into the night. A sight of raw beauty was my reward. . . a display of awe–inspiring power in a once–in–a–life–time setting, to be seen only by the privileged few who were



An Ultrabomb explodes on the 4th of January. The central pressure plummets 60 millibars in just 24 hours. The **Nedlloyd Holland** *recorded a 943–millibar pressure at 0300 on the 5th. The* **Stonewall Jackson,** *on the 4th, battled 65–kn westerlies in 38–ft seas. To the south of the center the* **Sealand Performance, Sheldon Lykes, American Resolute** *and* **Gypsum King** *were hitting 45– to 60–kn winds in 12–to 25–ft seas. The analyses above were done by Frederick Sanders, with fronts by the author. On the next page is a radar image of the Ultrabomb as the plane approached the center at about 0620Z on the 4th. There is a strong convective cell (white) just north of the aircraft.*



A tremendous bank of thunderstorms in all stages of development was framed by thousands of twinkling stars and the natural light of a full moon. Lighting flashes rippled and pulsed up and down the line. Jagged cracks of incandescence stabbed the air from the tops of building cumulonimbus calvus, which also glowed eerily from within, as if internal lightbulbs were being rapidly switched on and off.

These building young thunderstorms were flanked by the anvil towers of mature storms. What were severe thunderstorms doing out here in the middle of a winter cyclone? Well, they were over the Gulf Stream. And there was a 100–knot southwesterly jet blowing into the backs of these monsters at 18,000 feet. One could assume that considerable dynamic support was available for their development.

As on the previous mission, we tried to find the center. It was like searching for the proverbial will–o'–the–wisp. After coming close but never really quite reaching it, I concluded that a secondary center at the nexus of occlusion was racing in a southerly direction at some 50 to 60 knots, always keeping just ahead of us. And once again, the impression was that this center was only a few miles across.

The tremendous temperature gradient at our flight level in the vicinity of the jet stream was also of great interest. Indeed, the gradients of both temperature and windspeed were much greater than depicted on any 500–millibar analysis I had ever seen. The question was, is this common? Or was this storm unusual? The latter is at least a possibility because, as earlier events had foretold, we were witnessing the birth of an *ultrabomb*, an exploding cyclone whose central pressure fall averages at least 10 millibars per hour for six hours. Moreover, this storm's minimum central pressure of about 936 millibars occurred at a latitude farther south than in any similar storm I had ever seen.

Although I didn't reach home until 3:30 a.m. the next morning, my physical exhaustion was well worth it. It had been another enlightening, exhilarating experience, full of unique events and illuminating insights into the nature and processes of these surprising storms. I could see that a tremendously useful body of practical knowledge would come out of the ERICA Project.

Today I look back fondly on the tremendous privilege of participating in ERICA. The chance to do so such promising and exciting field work comes so seldom to a working forecaster and was a source of great personal pleasure and satisfaction. I strongly encourage others who might have the chance to take advantage of future opportunities to explore the real world of storms. I know I certainly will!

Acknowledgement

I am grateful to my colleagues at the Boston forecast office whose generosity made it possible for me to participate in ERICA. Without their encouragement and willingness to fill in for me on my shifts, I could not have taken advantage of this wonderful opportunity.

ERICA

The Experiment on Rapidly Intensifying Cyclones over the Atlantic (ERICA) field phase was successfully conducted between December 1, 1988 and February 28, 1989 over the western North Atlantic primarily from 30° to 50°N and westward from 45°W. The intent, described in an earlier issue of the Mariners Weather Log (Fall 1988), was to collect data that can be used to determine the differences between rapidly deepening winter storms and their more normal counterparts and to obtain new scientific understanding of the explosive stage versus the normal stages before and after,

We were fortunate in several ways. Many good storms occurred and were adequately observed, operations on land , in the air, and at sea, under severe weather conditions, were safely carried out as planned, and many organizations were able to participate with personnel and equipment to enhance the field program that was initiated by the Office of Naval Research.

As research with the data proceeds, it is evident to us that ship personnel made special efforts to obtain frequent and high–quality observations. These extremely important surface observations from ships, integrated with moored and drifting buoy observations, have provided detailed information of surface pressure and air temperature and moisture, along with sea surface temperature and winds. ERICA scientific participants thank all shipboard personnel and PMOs for their excellent effort during the ERICA Field Phase that made critical data available to us in a timely way for both operations and research.

— Ron Hadlock
ERICA Field Driector

"Just before sunrising, while I was yet asleep, Mr. Christian, with the master–at–arms, gunner's mate and Thomas Burkett, seaman, came into my cabin, and seizing me tied my hands with a cord behind my back, threatening me with instant death if I spoke or made the least noise."

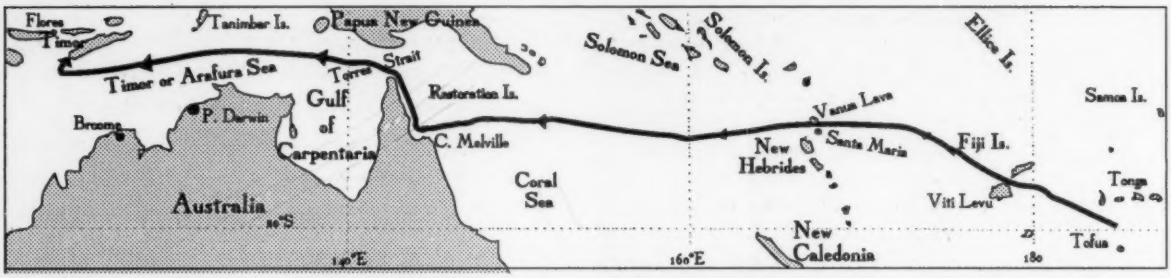
So reads the Journal of Captain William Bligh describing this climactic event aboard the H.M.S. Bounty. It also marks the beginning of one of the great voyages in maritime history.

Captain William Bligh
by George Dance, National Portrait Gallery, London

The following account was taken from several sources. *The Marine Observer* published the story in its April 1989 issue. It was compiled by Captain John Wells from *The Bligh Notebook*, a transcription and facsimile of Lieutenant William Bligh's rough account of his voyage in the Bounty's launch, published by Allen and Unwin in association with the National Library of Australia. Additional information was obtained from *A Book of the Bounty and Selections from Bligh's Writings*, George Mackaness (editor) published by J.M. Dent and Sons, 1938. The quotes in the story are from Bligh's journal.

The Incredible

le Voyage of William Bligh



The 3600 mile voyage began on the 28th of April 1789. Two days later, on the other side of the world, President George Washington was inaugurated in New York City. Captain Bligh and 17 of his men arrived in Kupang, Timor on the 14th of June.

Lieutenant William Bligh was appointed to command the armed transport ***H.M.S. Bounty*** in August 1787, to ship a delicate cargo of breadfruit seedlings from the Society Islands, French Polynesia, in the South Pacific, to the West Indies. Bligh, aged 33,served his apprenticeship under Captain James Cook, recognized as one of history's most distinguished explorers.

Bligh's command of 215 tons displacement and 90 feet in length had been extensively refitted to resemble a floating greenhouse. She was manned by a crew of 46, including Fletcher Christian and only two other men who had previously sailed with Bligh— the only commissioned officer on board.

"The women at Otaheite are handsome, mild and cheerful in their manners and conservation, possessed of great sensibility, and have sufficient delicacy to make them admired and beloved."

"Christian, in particular I was on the most friendly terms with....he excused himself from supping with me, on pretence of being unwell; for which I felt concerned, having no suspicions of his integrity and honour."

Bounty had sailed from Spithead at the end of December 1787; on encountering adverse weather when rounding Cape Horn the decision was made to alter course and proceed across the South Atlantic to the Cape of Good Hope. Tahiti was reached in October 1788 and the ship remained there until April 1789. During the 5 months of comparative inactivity, ship's company discipline was allowed to decline, many of the crew succumbing to the fatal attractions of native women and an easy–going way of life. Bligh may have been able to avoid this state of affairs, although he was subsequently reluctant to take the blame. Lower deck morale worsened after Bounty sailed for other islands, mainly due to Bligh's extraordinary behavior toward his men, particularly toward Christian.

A crew of 18 men were put into the launch that tuesday morning of April 28th, when Bligh was brought on deck Christian told him: "Come Bligh, your officers and men are now in the boat, and you must go with them; if you attempt to make the least resistance you will instantly be put to death." Once Bligh was in the boat a few pieces of pork, some clothes and four cutlasses were tossed in.

In disposing so swiftly of their commanding officer and his loyal supporters the mutineers were not unreasonable. Often mutineers murdered the Captain and loyal crew. The launch was a strongly built craft from White of Cowes, Isle of Wight, equipped with masts, sails and oars. Besides Bligh, there were Sailing Master Fryer, Boatswain Cole, Gunner Peckover, Carpenter Purcell, a master's mate, Midshipmen Hayward and Elphinstone as well as sailmaker, acting surgeon, quartermaster and his mate, two cooks, butcher and the botanist Nelson. In addition to chests containing the carpenter's tools and nails, there were spare sails, cordage, clothes, hammocks and navigational equipment. All that gear plus 19 men in a 23–foot boat made for an extremely uncomfortable situation, particularly in foul weather.

"After having undergone a great deal of ridicule, and been kept some time to make sport for these unfeeling wretches, we were at length cast adrift in the open ocean."

Under oars and heavily overladen the launch reached the island of Tofua. Landing on the island wasn't easy and, at first, there was little sign of life. When the natives did show up, requests for food and water were met by distinctly hostile reactions. On the 2d of May, as the sun was setting, Bligh decided

"The beach was lined with natives, and we heard nothing but the knocking of stones together, which they had in each hand. I knew very well this was the sign of an attack."

"As our lodgings were very miserable and confined for want of space I... put ourselves at watch and watch, so that one half always sat up while the other lay down on the boat's bottom or upon a chest. Our limbs were dreadfully cramped, for we could not stretch them out and the nights were so cold and we so constantly wet that after a few hours sleep we could scarcely move."

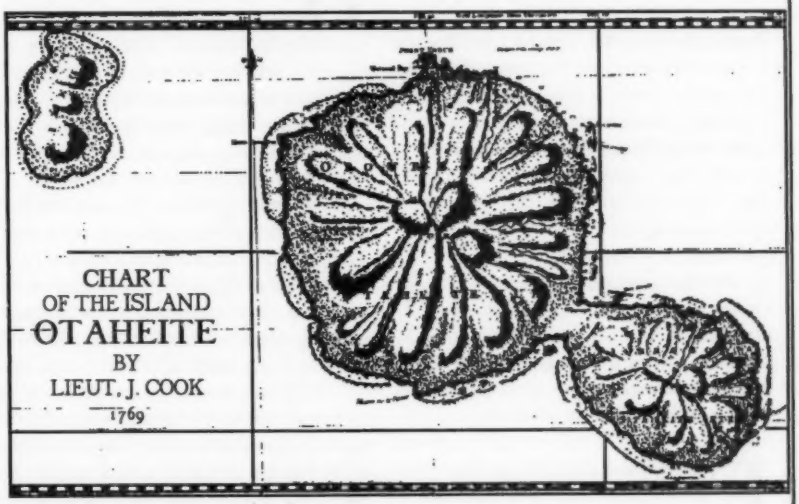
they had better get off the island. As soon as they were about ready to cast off, the attack began by about 200 men. Quartermaster, John Norton, who had run up the beach to push the stern off, was caught and stoned to death in the surf just as Bligh and the rest managed to make their getaway by cutting through the stern painter of the boat. Some of the natives filled canoes with stones and took off after them, but after sustaining numerous attacks they were finally able to get away. They set their sails and steered along the west side of the island as the winds blew fresh from the east. They were all frightened by this experience and it was decided that they would give all the islands as wide a berth as possible Bligh decided to head for Timor in the Dutch East Indies where he believed the welcome would be more friendly. Timor was some 3,000 miles away!

With the crew's assent Bligh started rationing at once, each man receiving daily an ounce of bread biscuit and a half pint of water, with the occasional morsel of pork or a teaspoonful of rum. Bligh improvised a pair of scales out of coconut shells, using musket balls as weights, to help share out the meagre rations three times daily. They had to press on under all sail that could be set to avoid starvation or dying of thirst.

Fortunately the Southeast Trades blew fairly constantly in direction if variable in strength and often accompanied by rains squalls which, however, at least renewed their water supplies. Acute discomfort was partially alleviated by Bligh's instructions to dip clothes into the warm sea and wring them out. Fifteen days of May passed before they were able to feel warm sunshine.

For navigation Bligh had a sextant, a quadrant, a compass taken from the Bounty's binnacle and a log line. To provide mathematical, astronomical and geographical data there were two well known books but no charts. For time keeping Bligh used Gunner Peckover's watch until it stopped on June 2; after that much of the navigation was by guess–work. The crew were taught to stream the log, a piece of wood shaped into a quadrant by Carpenter Purcell,

"At daybreak [May 3] the gale increased, the sun rose fiery and red—a sure indication of a severe gale of wind. At eight it blew a violent storm and the sea ran very high, so that between the seas the sail was becalmed, and when on the top of the sea it was too much to have set; but we could not venture to take in sail, for we were in very imminent danger and distress, the sea curling over the stern of the boat, which obliged us to bale with all our might. A situation more distressing has perhaps seldom been experienced."



"It will very naturally be asked, what could be the reason for such a revolt? In answer I can only conjecture that the mutineers had flattered themselves with the hopes of a more happy life among the Otaheiteans than they could possibly enjoy in England." This chart of Tahiti was made by Lt. James Cook (the Captain Cook) in 1769 and was engraved by J. Cheeven. Courtesy of National Maritime Museum, London.

thus measuring the distance run each watch. Throughout the voyage the average speed made good over the ground was 4 knots.

From the Friendly Islands Bligh sailed west through the Fiji group. He made sketches and detailed comments on the islands despite the overwhelming concern of survival. They sailed past many islands but were afraid to land. On the 7th they observed two large canoes quickly gaining on them but they were able to summon enough strength to row away. A short time later they ran into heavy rain and were able to catch some water, increasing their stock to 34 gallons. On the 9th, Bligh had a canvas weather cloth rigged up over the gunwales, which served to raise the sides by about 9 inches. This proved to be of immediate value as they ran into a thunderstorm that night. They caught about 20 additional gallons of water but were cold, wet and miserable. The sea broke over the stern for several days and they had to bail continuously to keep from swamping. Bligh attempted to keep morale up with judicious servings of rum during this cold and bitter period. He estimated that by the 10th they had sailed nearly 600 miles from Tofua. By the 14th they sighted the New Hebrides (now Vanuatu), which according to Bligh only served to increase their misery since they were little better than starving, with plenty in view that could relieve their suffering. At noon on the 17th they spotted a waterspout. The dark clouds prevented a noon sighting vital for determining position. Rain and rough weather continued as they crossed the Coral Sea. Finally, on the 24th of May, after two weeks of miserable weather the sun came out and the warmth was a blessing.

Early on the morning of the 28th, just one month after the mutiny, the sound of breakers on the Great Barrier Reef of Australia was heard. On reaching the Australian coast after 25 days at sea his latitude error was 2 miles and the total longitude error just 50 miles. Bligh's meticulous log showed course steered, distance made good, the accurate sets and leeway; all indicating his outstanding performance as a navigator. He also detailed the weather that they encountered.

Approaching the Great Barrier Reef, Bligh found that they had enough bread for only 29 days, hardly sufficient to reach Timor and the supper ration was therefore stopped. On closing land, bird sightings increased and boobies, caught by hand, were divided, entrails and all, among the men. Safely through the reef the boat arrived on May29th at what Bligh named "*Restoration Island*" {12° 37'S, 143° 27'E}, where the crew staggered ashore and found water, oysters, fern roots and the edible tops of palm trees. They rested in this area for 6 days recuperating from their ordeal, keeping clear of the natives on shore and in canoes and gradually working northward along the Australian coast until they were able to round Cape York in the Torres Strait and sail westerly for the port of Kupang on Timor.

Bounty's launch carried two masts, each with a dipping lugsail capable of reefing which was frequently done. Bligh had the masts fitted with shrouds in addition to a canvas weather cloth fitted around the boat. Even then, seas were continually shipped as the overloaded launch ran before the wind, making steering very difficult with the constant fear of broaching to and capsizing. While cleaning the boat on Restoration Island it was discovered that one of the rudder pintles had fallen out, which could have been disastrous had it occurred at sea.

Once in the Timor Sea they had to revert to bread and water for meals, until one day they were delighted to catch a dolphin, which made excellent eating. However, by June 10th Bligh recorded in his log that more than half his crew were approaching an end to their distress and he was none too sure of making a landfall, being uncertain of his exact longitude. Progress in the previous

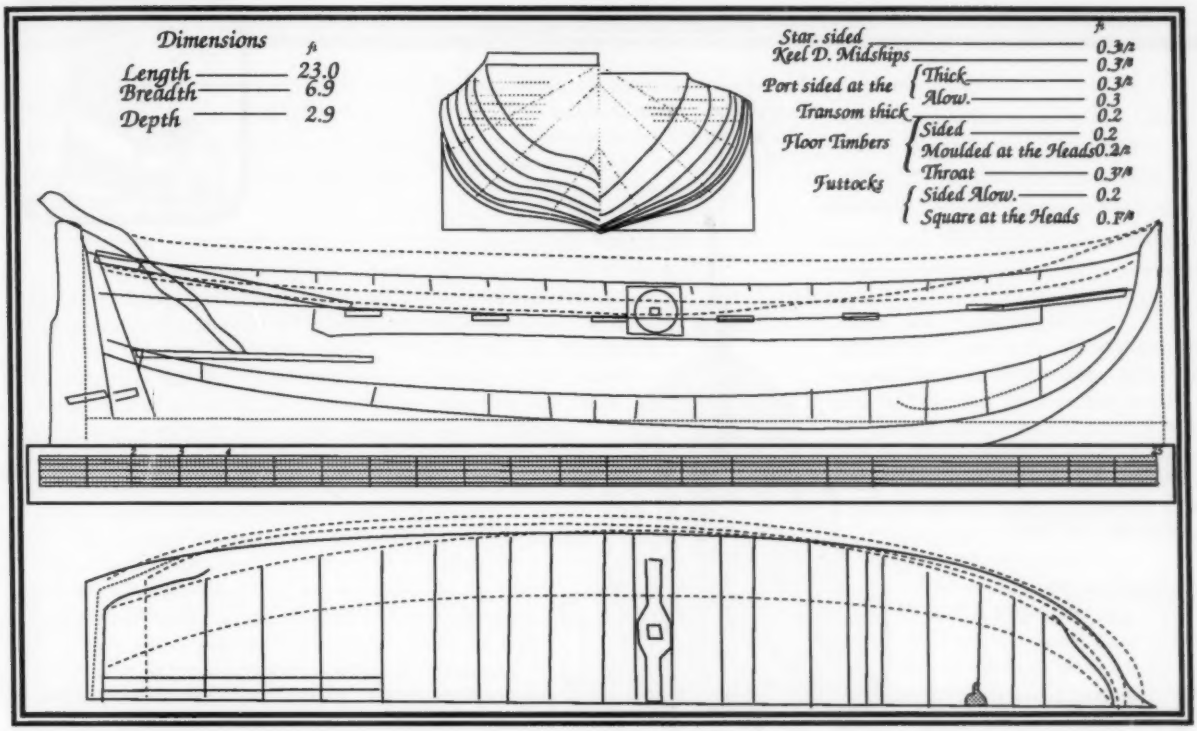
"If I may judge from the sail of these vessels, they are of a similar construction with those at the Friendly Islands... Whether these canoes had any hostile intention against us must remain a doubt."

"In the evening [11th] it rained hard, and we again experienced a dreadful night. At length the day came, and showed to me a miserable set of beings, full of wants without anything to relieve them.

"The idea of getting into smooth water, and finding refreshments, kept my people's spirits up. Their joy was very great after we had got clear of the breakers, to which we had approached much nearer than I thought was possible without first discovering them."

"Being now happily within the reefs, and in smooth water, I endeavored to keep near them to try for fish, but the tide set us to the NW. I therefore bore away in that direction, and having promised to land on the first convenient spot we could find, all our past hardships seemed already to be forgotten."

"The hopes of being able to accomplish the voyage was our principal support. The boatswain very innocently told me that he really thought I looked worse than anyone in the boat. The simplicity with which he uttered such an opinion amused me, and I returned him a better compliment."



The Bounty's launch was a skeg–built boat 23 feet long by 6 feet 9 inches beam, by 2 feet 9 inches depth (from rail to keelson). While it usually drew 2 feet, with 19 men and supplies it drew over 3 feet leaving just 7 to 8 inches of freeboard. The launch was designed to be rowed by five or six pairs of oars with two men on each thwart pulling an oar apiece. In addition it carried two masts with sails but no jib.

"It is not possible for me to describe the pleasure which the blessing of this land diffused among us. It appeared scarcely credible to ourselves that in an open boat and so poorly provided we should have been able to reach the coast of Timor in 42 days after leaving Tofua having in that time run, by our log, a distance of 3,618 miles and that, notwithstanding our extreme distress, no one should have perished on the voyage."

two days had been frustratingly slow and it was not until the evening of Sunday the 14th that he entered the port of Kupang where they were able to land.

They were hospitably received by the Governor of Timor, who offered friendship and assistance, but their troubles were not over. First the Botanist, Nelson, died, then five others in steady succession; Bligh himself gradually recovered after moving to a healthier part of the island and receiving treatment from a doctor. Bligh and the remainder of the survivors reached England in March 1790; some time later, 14 of the mutineers were brought to trial.

William Bligh may not have run a happy ship, his chief defects being conceit, tactlessness and insensitivity to the feelings of others, but he was nevertheless and officer of great integrity and punctilious devotion to duty. No one can take from him his qualities of leadership, courage and skill as a navigator and seaman, for which he deserves the highest possible credit.

NOTE: To commemorate the 200th anniversary of this remarkable feat, the William Bligh Trust was formed in 1987 in order to build a replica of the launch and a crew of six was selected to re–enact the voyage from Tofua to Timor in April 1989. Initiative for this project belongs to Jasper Shackleton, who personally built the launch from drawings obtained from the National Maritime Museum, Greenwich, using larch and English oak. He also skippered the boat, named ***Elizabeth Bligh***, after Bligh's wife.

"My Dear Betsy,

I am now in a part of the world that I never expected; it is, however, a place that has afforded me relief and saved my life... What an emotion does my heart and soul feel that I have once more an opportunity of writing you and my little angels [daughters] ..all these dreadful circumstances I have combatted with success, and in the most extraordinary manner that ever happened..."

West Quoddy Head Lighthouse

Elinor DeWire

The easternmost soil on the mainland of the United States lies near the quiet town of Lubec, Maine on a slender peninsula called West Quoddy Head. It points like a long accusing finger at Sail Rocks, a jagged pile of granite that resembles a ship's sail. The Passamaquoddy Indians believed these rocks to be the stepping stones of a giant that lived on Canada's Grand Manan Island.

Champlain navigated his way around these rocks almost four centuries ago on his way to nearby Dochet Island in the St. Croix River. The French colony he helped establish there was called Acadia and was the site of the first Christmas celebration in North America. Snow-frocked and framed by majestic spruces, it lies almost half way to the North Pole.

Vessels still give the Sail Rocks a wide berth, but since 1808 navigators have used the warning beam of West Quoddy Head Lighthouse to help them avoid this dangerous ledge. Built by direction of President Thomas Jefferson, it is one of the prettiest sentinels in New England.

When the last Coast Guard keeper was removed from West Quoddy Light in 1988, the town of Lubec petitioned for a caretaker. There was concern about the safety and upkeep of the tower. In addition, many residents felt West Quoddy Light's long tradition as a sentinel should be preserved as a museum with a resident curator. Although Lubec has yet to find funding for this project, the state of Maine has assumed responsibility for the lighthouse grounds.

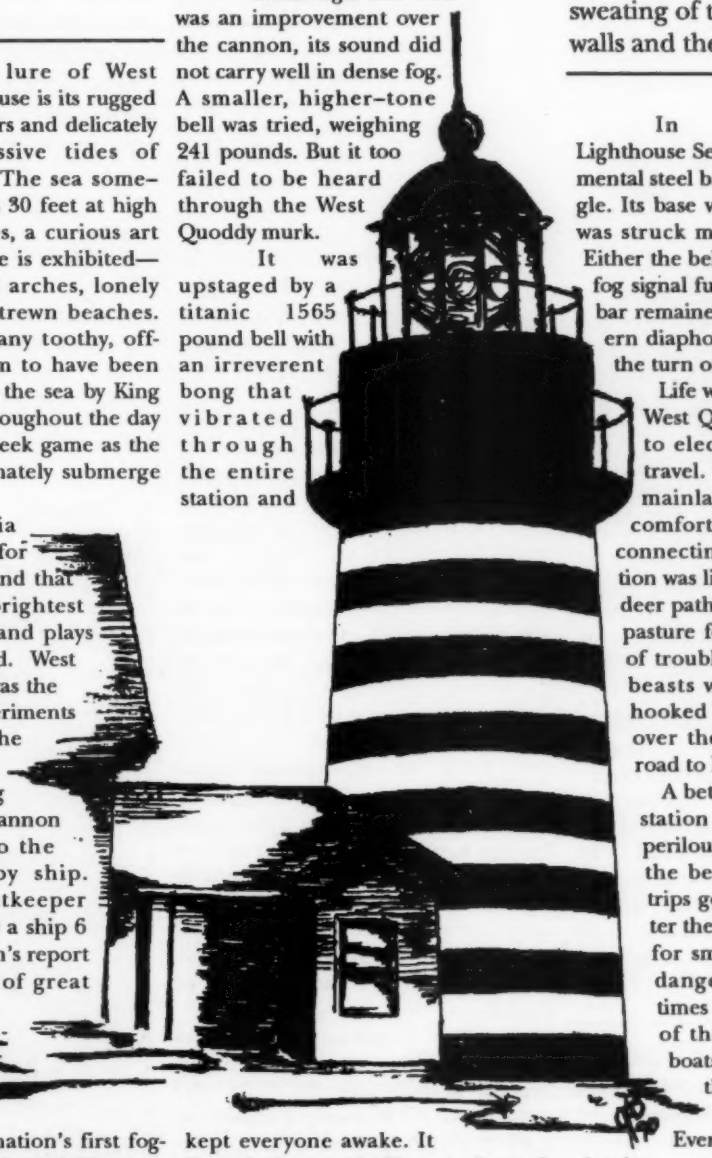
Elinor DeWire

As part of West Quoddy Head State Park, this lighthouse receives more than 65,000 visitors each year. At local gift shops souvenir hunters can find its image on a multitude of collectibles, from postcards to mugs to stationery. It's one of the most popular and historic landmarks in the region. The next page contains a pen and ink sketch of West Quoddy Lighthouse by the authors' talented daughter, Jessica.

The Acadia Coast is known for its fog— the pea–soup kind that smothers even the brightest navigational beacon...

Part of the lure of West Quoddy Head Lighthouse is its rugged coastline, cut by glaciers and delicately carved by the massive tides of Passamaquoddy Bay. The sea sometimes rises as much as 30 feet at high tide. When it recedes, a curious art show of rock sculpture is exhibited— marvelous caves and arches, lonely stacks, and cobble–strewn beaches. Sail Rocks and its many toothy, offshore neighbors seem to have been mindlessly tossed into the sea by King Neptune himself. Throughout the day they play a hide and seek game as the enormous tides alternately submerge and expose them.

The Acadia Coast is also known for fog— the pea–soup kind that smothers even the brightest navigational beacon and plays nasty tricks with sound. West Quoddy Head Light was the site of numerous experiments with fog signals in the 19th Century. Its first fog warning device was a 5–foot cannon fired in response to the whistle of a nearby ship. Although the lightkeeper could sometimes hear a ship 6 miles away, the cannon's report was too brief to be of great benefit. The gun was also dangerous — and keepers complained about having to fire it.



In 1820 the nation's first fog-bell was tried at West Quoddy Head. It weighed 500 pounds. and was struck by hand. To assuage the discontent of keepers, who sometimes stood hammering the bell for days, the government added a $70 bonus to the annual salary of $250. (An additional $50 had been given earlier, after complaints that the soil around the lighthouse was too poor to garden.)

Although the bell was an improvement over the cannon, its sound did not carry well in dense fog. A smaller, higher–tone bell was tried, weighing 241 pounds. But it too failed to be heard through the West Quoddy murk.

It was upstaged by a titanic 1565 pound bell with an irreverent bong that vibrated through the entire station and kept everyone awake. It hung in its own bellhouse above the surf with a weight that descended down to the beach to actuate the striker, somewhat like the clockworks of a cuckoo clock. But even the low, mournful song of this monstrous bell could not penetrate the thick air.

A serious difficulty for early lightkeepers was the constant sweating of the interior masonry walls and the iron lantern cap.

In desperation, the Lighthouse Service installed an experimental steel bar in the shape of a triangle. Its base was 14–feet across and it was struck much like a dinner bell. Either the bell worked satisfactorily, or fog signal funds ran out, because the bar remained in service until a modern diaphone horn replaced it near the turn of the century.

Life was not easy for families at West Quoddy Head Light prior to electricity and automobile travel. Though situated on the mainland, access to mainland comforts was limited. The road connecting the station to civilization was little more than a widened deer path. Early keepers had poor pasture for their horses and a lot of trouble catching the unhappy beasts when it was time to be hooked to the wagon for a trek over the potholed, rut–riddled road to Lubec.

A better choice was to take the station boat. Still, this meant a perilous climb down a ladder to the beach and tide–propelled trips going and coming. In winter the sea was usually too rough for small boats, and ice was a danger. Large chunks sometimes rode the tides in and out of the bay. Not until motorboats and cars came along was the semi–isolation at West Quoddy Head broken. Even today, the nearest neighbor is over a mile away.

A serious difficulty for early lightkeepers was the constant sweating of the interior masonry walls and the iron lantern cap. This was especially bad in winter when the moisture froze

West Quoddy Head Light is 83 feet above the water. To the right the postage stamp is made into a puzzle. Elinor DeWire

and glazed up the lantern windows, obscuring the light. A stove had to be kept going inside the lantern for most of the year to keep it dry, and it required much more coal and wood than keepers would normally have used.

Godfrey noted that the lantern had lamps facing all directions, including the forested area behind the lighthouse.

In 1842 keeper Alfred Godfrey revealed another expensive practice at West Quoddy Light, however this time a simple solution was offered. Godfrey noted that the lantern had lamps facing all directions, including the forested area behind the lighthouse. He proposed removing the lamps that faced landward, thus reducing the lighted arc to 240°. His suggestion resulted in considerable savings on oil each year.

The current masonry tower at West Quoddy Head was built in 1858 to replace the original rubblestone sentinel. Sometime after its commissioning, it was given its famous red and white stripe daymark. The Canadians popularized the practice of painting red stripes on lighthouses. Though handsome, the stripes are not cosmetic; rather they show up well in regions where snow blankets the coast. Only one other U.S. lighthouse sports red and white horizontal stripes from lantern to base— Assateague Light in Virginia.

The visual appeal of West Quoddy Head Lighthouse has earned it many honors over the years, but none so lofty as its recent inclusion in the U.S. Postal Service's commemorative series of lighthouse stamps. Only five were chosen to represent the 750–plus lighthouses that still stand in the U.S. West Quoddy Light's bold stripes clearly dominate the series.

The visual appeal of West Quoddy Head Lighthouse has earned it many honors over the years, but none so lofty as its recent inclusion on the U.S. Postal Service's commemorative series of lighthouse stamps.

Unfortunately, there is one small error on the stamp—a mistake that matters very little considering the intent of this series. Lighthouse fanciers will spot it immediately. Count the number of stripes on the stamp, then count the stripes in the photographs. Cameras don't lie!

Dear Sir

I trust I have this directed to the proper offices, if not please forward on.

My question revolves around your barographic chart, which is routinely supplied to cooperating observer ships by your Port Meteorological Officers, and upon request by mail (NWS Form 455–12).

At age 48 my eyes aren't, of course, what they used to be, but give me a break on this barograph form. It is so lightly printed it is next to impossible to read unless you are right on top of the barograph. All you can see from across our chart table (unless you bend over the table to attempt to get closer) are blurred, light brown lines and the clear, black trace of the barograph pen. The GMT markings and millibar markings are reduced from a brown blur to clarity when I do the 90° bend over the chart table to get within a few feet of the graph. At night with chart table lights on I additionally require a flashlight.

The younger Deck Officers aboard (with presumably better vision, although I don't wear glasses) also complain about the difficulty in reading the graph.

Can't the darkness and contrast of the brown millibar and time lines on the chart be increased for easier reading? Possibly the printing office has a reason for this, if so please so advise me. If not hopefully the readability of this vital instrument can be improved for our everyday continual use aboard ship.

Very truly yours,

Peter S. Smith, Master
M/V Sea Land Express KGJD
Sea Land Service, Inc

This seems to be a problem that has cropped up in the recent past. The original intent of the lighter printing was to highlight the barograph trace so that it wouldn't get lost among the lines of the graph. However I think they overdid it. I like to use these charts to illustrate the weather over the oceans, but lately they have been much too faint to reproduce with any clarity. This topic was brought up at the recent PMO conference and all agreed that it was a problem. In addition there seems to be a shortage of barograph charts so it is possible that we can get to the proper authorities in time for the next printing. I want to thank Captain Smith for his letter. If anyone has a gripe or comment on the observation program please write to the Mariners Weather Log or the Marine Observation Program Leader. Both addresses are in the back of this issue.

Origin of the Species and the Weather Bureau

Robert Novak, PMO
San Francisco

Just what did Darwin have to do with the beginning of the U. S. Weather Bureau? Maybe more than anyone thought. The background— A popular scientific myth holds that Darwin sailed on the ***Beagle*** as official ship's naturalist. This is not true. The official naturalist was the ship's surgeon, Robert McKormick. Darwin, who disliked McKormick and did eventually succeed him as naturalist, (after the disgruntled McKormick *invalided out*, to use a popular term for that period), originally sailed as a supernumerary passenger at Captain Robert FitzRoy's discretion.

Why was Darwin chosen by FitzRoy for the voyage? The obvious answer — Darwin could help improve observations — may be partly true, but does not get to the heart of FitzRoy's reasons. FitzRoy took Darwin along primarily for a much different, and personal reason. As an aristocratic captain, and following the naval custom of his time, FitzRoy had no social contact with officers of crew during long months at sea. It's hell at the top. He dined alone and conversed with his men only in an official capacity. FitzRoy grasped the psychological toll that such enforced solitude could impose, and remembered that the previous captain had suffered a mental breakdown and shot himself. Darwin then, at his own expense, came along to serve, in large part, as a mealtime companion for Captain Fitzroy.

Why did FitzRoy dread the rigors of solitude? How does this tie in with the beginnings of the Weather Bureau? Read on. The answer may lay in Darwin's autobiography, the chapter on the Captain:

FitzRoy's character was a singular one, with many very noble features: He was devoted to his duty, generous to a fault, bold, determined, indomitably energetic and an ardent friend to all under his sway... He was a handsome man, strikingly like a gentleman, with highly courteous manners, which resembled those of his maternal uncle Lord Castlereagh (British foreign secretary in 1827, Congress of Vienna, Treaty of Ghent, etc.)... FitzRoy's temper was a most unfortunate one. This was shown not only by passion but by fits of long-continued moroseness... He was also somewhat suspicious and occasionally in very spirits, on one occasion bordering on insanity. He was extremely kind to me, but was a man very difficult to live with on the intimate terms which necessarily followed from our messing (eating) by ourselves in the same cabin.

Tragically, FitzRoy's premonition eventually came to pass in almost eerie consonance with his own nightmare and memory of Lord Castlereagh. FitzRoy's suffered from several bouts of prolonged depression, accompanied by increasing suspicion and paranoia. In his last post FitzRoy served as chief of the newly formed Meteorological Office and became a pioneer in weather forecasting. He is much admired for his cautious and excellent work in a most difficult field. However, he encountered severe criticism during his own tenure for the obvious reason. Weathermen today are harassed for incorrect predictions. Imagine the greater problems more than a century ago. With a healthy mind, FitzRoy might have shaken the criticism, but he sank into even deeper despair and eventually committed suicide, in the same manner his uncle Lord Castlereagh. FitzRoy slit his throat on April 20, 1865.

How does Darwin fit into all this? Darwin's mealtime conversations on his discoveries and ideas could have kept FitzRoy's mind healthy allowing him to eventually become the first chief of the Meteorological Office. His demise may have been a harbinger of similar events involving other forecasters. Francois Arrago, a famous French Meteorologist, once wrote that "scientific men who value their reputation would never attempt to predict the weather." Mark Harrington, First Chief of the U.S. Weather Bureau, went mad after several years on the job. In 1906, the then Chief of the U.S. Weather Bureau, W.L. Moore, told a Senate Committee that the U.S. Weather Bureau had sent more men to the insane asylum than any other branch

of government. So Darwin's actions aboard the Beagle may have indirectly helped to prove this hypothesis on a worldwide basis. Lord Castlereagh may also have had a tenuous link to the Weather Bureau. He was involved with The Treaty of Ghent, which made the Battle of New Orleans a heroic conquest for Andrew Jackson's emergence as a military hero and national figure ripe for the presidency. What did Andrew Jackson have to do with the origin of the Weather Bureau— that's another story.)

Getting to Know Your PMO

Bob Webster, PMO Los Angeles

Bob Webster is the Port Meteorological Officer for Los Angeles–Long Beach area. This is a large and important port. In 1989 there were almost 7 thousand vessel arrivals in this area. Last year Bob visited more than 1,000 ships. I would like to thank him for his time for this interview.

MWL: Did you begin in the NWS as a PMO?

Bob: No, I started with the NWS in 1972 taking upper air soundings in San Diego. I later transferred to the Los Angeles area working as a weather observer at Los Angeles International Airport and then as a Weather Service Specialist at the Los Angeles Forecast Office. I became the Supervisory Meteorological Technician there in 1983 and worked in that position until becoming the PMO in 1987.

MWL: How about work prior to the NWS?

Bob: I was in the Air Forces's Air Weather Service for 4 years, spending most of my time in Phoenix, AZ, except for a 1 year tour in 1971 as Chief Observer at Long Than North Army Installation, Viet Nam.

MWL: The Los Angeles-Long Beach area seems pretty extensive. Do you travel a lot?

Bob: The area is indeed extensive, however the port area is compact. By traveling only 20 to 25 miles a day I can get to virtually every berth in both harbors.

MWL: What ships are most prevalent in your area?

Bob: By far most ships that come into my port are coming from the Pacific Rim. Of the nearly 7,000 ships that came to the ports of Los Angeles-Long Beach, 5,700 were foreign.

MWL: Are there differences in the East and West Coast PMO duties or functions that you are aware of?

Bob: I believe they are basically the same. I do think that some of the East and Gulf Coast PMOs are more involved in other marine programs such as coastal observation programs. West Coast PMOs are almost exclusively involved in the VOS program. Other marine programs are handled by the Marine Focal Points at the various forecast offices.

MWL: If you could make one improvement (budgetary considerations aside) to the PMO program what would it be?

Bob: Too many ship's weather observations are never received by the National Weather Service. Many times it is because there may not be a radio officer on duty when the observations are made; other times the observations are lost in the system. I would like to see us someday be able to provide each of our good observing ships with some kind of SEAS unit (satellite transmission of the weather report to the NWS). This would allow every observation to be received in a timely fashion at NWS and other national weather services.

MWL: How about your family?

Bob: My wife, Kimberly, and I have been married 5 years and we have a 3 year old daughter, Jessica.

MWL: How close do you live to your office?

Bob: Luckily only 5 minutes away. I was born and raised here in the harbor area and have lived most of my life in the San Pedro/Harbor City area.

MWL: Is your office separate from other NOAA offices?

Bob: It's separate from other National Weather Service offices, but not NOAA. My office is in the U.S. Customs House on Terminal Island and within NOAA's National Marine Fisheries Southwest Regional Office.

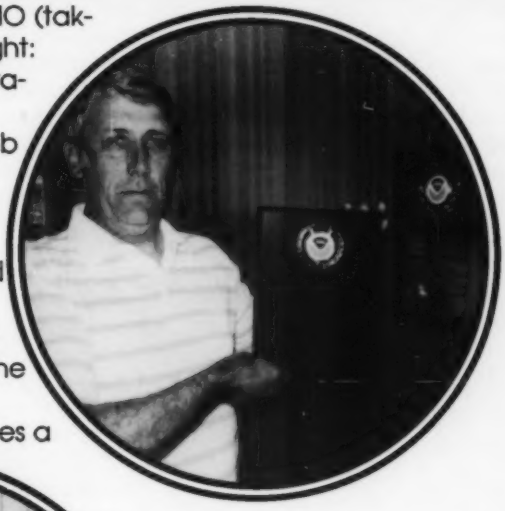
Center: NOAA Ship ***Whiting:*** left to right are Cdr. Floyd, SS Barney, CQM Jaynes, OS Myers Ens. Wingate, Lt Cohen, Ens. Taggart and ST Cruz. Ray Brown, PMO Norfolk made the presentation. Upper left: the infamous Houston PMO Jim Nelson, presents an award to Capt. Alberto Orozco de Niz of the ***Tabasco***. Upper right: Captain Alan G. Putnam of ***Sea Land Quality*** accepts company award for Sea Land from Newark PMO, Jack Warrelmann.

Through the Porthole

The following are some more 1989 Awards for outstanding contributions to the Voluntary Ship Observing Program.

Lower right: Jack Warrelmann presents an award to Capt. Tom Seesink (left) of the ***Sunbelt Dixie***, a Great American Lines vessel. Lower left: Capt. Vittorio Fabietti, Chief Coordinator for Carnival Lines accepts plaque for the company from Miami PMO Pete Connors.

Bakeman, Seattle PMO (taking photo). Upper right: Bakeman is cameraman again as Capt. Karl Jacob Birkeland receives the ***Westwood Jago***'s second straight award. Lower right: Aboard the ***Puritan***, Capt. Harold Blum receives a



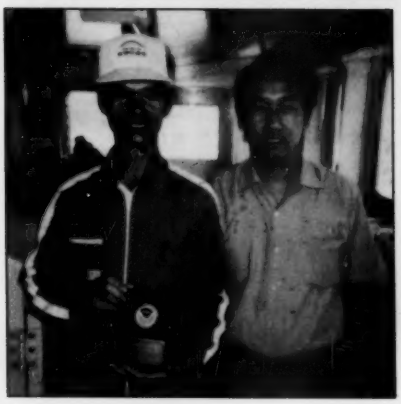
Center: Guess who, from Houston, presents an award to Sea Land in the person of William Prindiville, G.M Vessel Ops. Gulf, as Jose L. Dominguez, Manager, Vessel Ops., looks on. Upper left: Capt. Felix Francis Tauro displays the award for the MV ***Pacduchess*** from Dave

Lower left: One more time, Jim (Mr. Photogenic) Nelson does the honors. Receiving this award is Captain Alan G. Hinshaw of the ***Sea Land Performance***, along with Jose L. Dominguez, who evidently has decided that Nelson shouldn't have the spotlight by himself.

plaque from New Orleans PMO Jim Downing. The MV ***Puritan*** is a German flag ship that takes bathymetric. and meteorological observations in the Gulf of Mexico and does a great job.

The awards continue: below, the first presentation is made by San Francisco PMO, Bob Novak (left) to Capt. Saunders A. Jones, the Asst. Supt. of Marine Ops. for the American President Lines. Collectively APL Ships transmitted over 3,000 radio observations in 1989. The other two below are from the ***Tai Chung***; upper: Capt. Fu Chien-Mong (left) and 2d Officer Huang Len May; lower: Chief Officer Chern Jenq Tya (left) and Chief Engineer Chen Hui Ming. Right: aboard the ***Tropicale*** Capt. G. Gallo receives and award from San Juan MIC, Israel Matos while Stan Holland looks on.

Below, right: Ray Brown, Norfolk PMO visits the U.S.C.G. cutter ***Cherokee***. Ray presented a well deserved plaque— the first to an East Coast cutter. Receiving the award are (from left):Mr. Roads, Lt. Paul Steward, Mr. Eriksen, Lt. Cmdr. Jim Decker, Mr. Borders and Mr. Brubaker. Photo by PA3 David Oney.



The Mackinaw Race and Seattle were on Bob Collin's summer agenda. Bob, the Chicago PMO, sent in several photographs showing how he spent his summer. Above, left Capt. Bob Parsons, commanding officer U.S.C.G. cutter ***Mackinaw***, talks with Paul Dailey, Area Manager, National Weather Service Forecast Office, Chicago. Paul, James Vermoch, and Bob were guests of Capt. Parsons during this summers Mackinaw Race. Paul Dailey and James Vermoch (above, right) enjoy the calm and balmy waters along the Chicago lake front. At the PMO Conference, in Seattle, this is the view (below, left) Jim Nelson saw before he decided to stay on the ground and wait for the rest of us. It must have been pretty terrifying for Jim to miss a photo op (below, right), but the editor and Ray Brown (right) enjoyed the view.

What is the Difference Between a Sea and an Ocean?

Rosa T. Washington
National Oceanographic
Data Center

The *Flying Dutchman* has been sailing the *Seven Seas* for more than 300 years. The Captain was a wicked man and it was said had sold himself to the devil. One day he was sailing through a storm toward the Cape of Good Hope, cursing the maker of weather, when a being from heaven descended and reprimanded him for such language. This did not deter Captain Fokke, and so a curse was placed upon him and his crew. For all eternity they were doomed to wander the *Seven Seas* hungry and thirsty without knowing the pleasure of beer or tobacco again.

The term *Seven Seas* dates back to ancient times referring to the seas known to the Mohammedans before the fifteenth century. These were the Mediterranean Sea, Red Sea, Persian Gulf, Adriatic Sea, Black Sea, Caspian Sea and the Indian Ocean. Rudyard Kipling popularized the expression *Seven Seas* by using it as the title of a volume of poems.

The term *Ocean* dates back to ancient Greece. The Greeks thought the world was a flat disk, around which flowed a great river wider than anyone could imagine. They were so impressed by its power, although they could only see the Mediterranean, that they named it *Oceanus*, the beginning of all things— the father of gods as well as men. Most early people that looked upon the ocean gave it some supernatural origin.

The world ocean is composed of five interconnecting components, which cover an area nine times that of the earth's moon. The five bodies of water that comprise the global ocean are the Pacific (North and South), Atlantic (North and South), Indian, Arctic, and Southern (often called Antarctic). The Pacific is the largest of the world's oceans covering more than 64 million square miles. The Atlantic Ocean (North and South) extends for 32 million squares miles. The Indian Ocean occupies 25million square miles and the Southern Ocean is 13.5 million square miles in size. The Arctic Ocean is the smallest covering little more than 5.4 million square miles.

The terms sea and ocean are often used interchangeably in referring to salt water. However, geographically speaking, a sea is a body of water which is substantially smaller than an ocean or is a part of an ocean. Seas are classified as being enclosed or partly enclosed. The Caspian Sea and the Dead Sea are enclosed salt water basins with no outlet to the ocean. In contrast, the Mediterranean Sea, an almost totally land–locked basin, is an example of an enclosed sea which connects to the Atlantic Ocean through a narrow channel, the Strait of Gibraltar. The Weddell Sea is a partly enclosed sea which has a much wider channel to an ocean. The North Sea is another example of a partly enclosed sea.

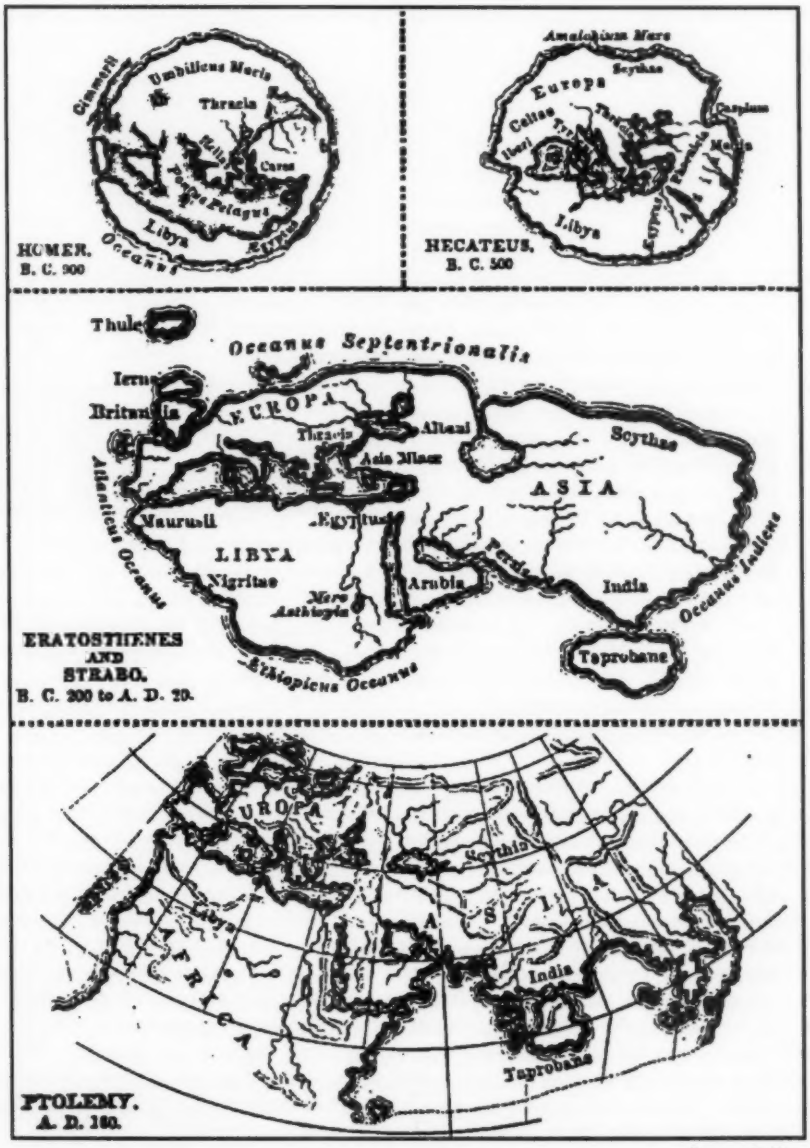
In modern terminology *Seven Seas* is often used to refer to the North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern and Arctic Oceans. Thus the world's

oceans have become the legendary *Seven Seas.* The oceanographic community recognizes the sea count as fifty–four.

Some seas are seas within seas. The Mediterranean Sea contains seven seas. They are the Alboran, Balearic, Ligurain, Tyrrhenian, Adriatic, Ionian and Aegean. One could sail the seven seas (of the Mediterranean) today without ever venturing into an ocean.

For further reading on this subject an interesting source is *Peter Freuchen's Book of the Seven Seas,* Published by Julian Messner, Inc., New York, NY.

Rosa T. Washington of the National Oceanographic Data Center has recently retired. She worked in the Data Services Division and is one of the last of the original NODC employees. The NODC was formed in 1961 from a part of the Naval Oceanographic Office. Rosa wil be missed in this office.



Bettmann Archives

These maps show the progression of knowledge of the oceans. In the time of Homer the Oceanus was a great river encircling the flat earth. The Mediterranean and surrounding land masses were better depicted by Hecateus some 400 years later. Knowledge of land and ocean improved dramatically by the time of Christ. The Atlantic, Indian and Northern Oceans were recognized while Europe, Asia, and Africa were taking shape. Ptolemy knew the world was round and this is seen in his meridional lines. His chart was so accurate for its time that it wasn't improved upon for another thousand years.

VOS Program Review

Martin S. Baron
National Weather Service

With 1465 Selected, Supplementary, and Auxiliary ships, the United States Voluntary Observing Ship (VOS) Program is at a 10 year high in participating vessels, and is the second largest VOS program in the world. These are the latest figures. The figure in the table on page 38 is for comparative purposes. Kudos to our Port Meteorological Officers for their very successful ship visitation and recruitment service. Thanks also go to ship's officers taking part in the program, for their time and effort in recording, transmitting, and mailing observations. Weather forecasts and analyses over vast marine areas would not be possible without your cooperation and teamwork.

Vessels in the U.S. VOS program produce about 600 real-time weather reports a day (18,000/month). This is about 18% of the total ship reports made by vessels in all VOS programs worldwide (about 100,000 reports/month). U.S. coastal radio stations (Coast Guard, INMARSAT Coast Earth Stations, and commercial radio stations) actually handle about 35,000 ship weather reports each month—many vessels in foreign VOS programs call at U.S. ports and send reports to U.S. stations from nearby marine areas.

Vessels using radio relay stations listed in the publication *Radio Stations Accepting Ships Weather And Oceanographic Reports* never pay any transmission costs. The NWS pays all transmission costs for reports from it's marine forecast areas — Pacific ocean: 160°E to the coast, and north of 25 °S; Atlantic ocean: 35°W to the coast, and north of 3°N, including the Gulf Of Mexico, and Caribbean sea. The NWS also pays transmission costs from the Guam area — between 5° and 25°N, and 135° to 160°E, and from all areas south of 60°S. Outside of these areas, foreign stations/governments listed in the publication will pick up all transmission costs.

Selected, Supplementary, and **Auxiliary** are the World Meteorological Organization classifications for weather reporting ships. By definition, a selected ship station is a mobile ship equipped with high quality, certified, meteorological instruments. These normally include an aneroid barometer, a sea water thermometer (either mounted to the ship's condenser intake, or a bucket thermometer), a sling psychrometer (for air, dew point temperatures, and humidity), and in most cases, a barograph. The meteorological instruments supplied by NWS PMO's meet rigid standards and are tested by the NWS before distribution aboard ship. Some selected vessels, about 20%, have anemometers, but most estimate wind speed by observing the sea state using the beaufort scale. The U.S. VOS program has 455 of these selected class vessels.

Supplementary and Auxiliary ships have limited time and means available on board to take and transmit weather observations. Time permitting, these vessels do a commendable job. Some auxiliary ships do not have certified meteorological instruments. The U.S. has 379 supplementary and 631 auxiliary class vessels.

The U. S. also has 71 great Lakes class vessels in the program, which take coded messages once every 3–hours. Vessels on the Great Lakes do not report swell, since, in most circumstances, the lakes are not large enough (insufficient fetch) for swell to develop. Great Lakes class vessels do not currently report pressure but a proposal to change this is now being considered. There is also a number of *local* weather reporting ships in the program, which take plain language reports, similar to Mariner Reports, or "MAREPS" as they are commonly known.

Besides the U.S., 48 other countries have VOS programs, shown in the table on page 38 . Foreign VOSs visiting American ports receive full service and assistance from our Port Meteorological Officers. Over 300 such foreign vessels are on our computerized mailing list as "complimentary" vessels, because they frequently visit U.S. ports. These vessels receive the Mariners Weather Log, and other NWS observing materials.

New PMO For Baltimore

James F. Saunders (above) is the new PMO at Baltimore, Md., replacing Bob Melrose who is now a specialist at the Weather Service Office (WSO) in Baltimore. Jim was born in New Bern, North Carolina, but has lived in northern Delaware most of his life. After graduation from high school, he spent 4 years in the air force, at Eglin AFB, Fl., Clark AB, Phillipines, and Volk Field, Wi. Jim came to work for the National Weather Service (NWS) in 1970, at WSO Wilmington. He worked as a communications and then a weather service specialist at the NWS Philadelphia, and Pittsburgh offices, returning to Wilmington in 1976 where he's spent the past 14 years. Jim is looking forward with great anticipation to his new duties as PMO.

New Recruits — July-Sept, 1990

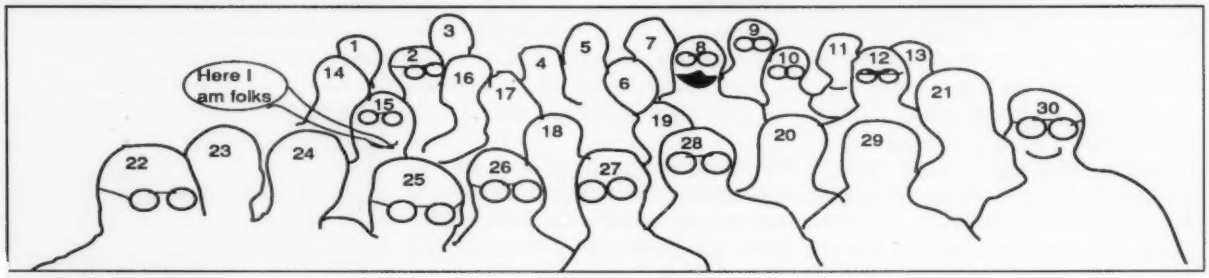
PMO's recruited 26 vessels into the VOS program during July, August, and September, 1990. Many thanks to these vessels for entering the program.

New Recruits

Arthur Maersk	OXRS2	Maersk Line
California	WSBA	American President Lines
Cape Borda	WLBP	" " "
Cape Bover	WATW	" " "
Cape Breton	WLDD	" " "
Cape Horn	KMJS	" " "
Cornhusker State	KAFQ	Interocean Management Company
Hyundai No. 1	D8PT	Hyundai Merchant Marine USA IC
Jovian Luzon	DZFS	Daido Kaium Kaisha Ltd.
Kathleen Pearcy	KDVG	Pearcy Marine
Marie Maersk	OULL2	Maersk Line
Ming Comfort	BLIA	Solar International Shipping
NCC Najran	LAFL2	Skibsaksjeselskapet Storli
New Horizon	ELHT5	Consolidated Maritime Service
Nomadic Lady	LALV2	Seatrans
Nova Europa	VROD	Univan Ship Mgmt Ltd.
Ocean Conqueror	ELFZ3	Amoco Transport Company
Ocean Explorer	ELHS6	" " "
Ocean Leader	ELIT6	" " "
Pacific Arrow	JGFM	Maersk Lines
Reform	LAHA4	A/S Borgestad
USNS Albert J. Myer	NZRM	Commanding Officer
USNS Meteor	NBIJ	Transmarine Navigation Corp.
USNS Pecos	NPEC	Commanding Officer
Whitting Sea	A8UF	Amoco Transport Company
Zim America	4XGR	Zim Container Service

New York Recruit

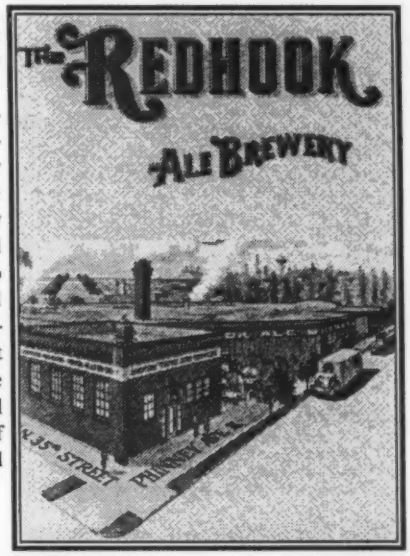
In photo at right, Capt. James C. DeSimone (left), Commandant of Cadets and master of the State of New York Maritime College training ship ***Empire State*** receives a plaque from Vince Zegowitz, the Marine Observation Program Leader for NWS. Vince participated in the summer training cruise aboard the Empire State with some 400 cadets, and instructed them in the importance of observations and the details of taking a good observation.



1. Marty Baron
2. Bill Burton
3. Jeff Bowman
4. Steve Rinard
5. Bob Novak
6. Larry Cain
7. Ron Fordyce
8. Dick Unruh
9. Dave Lamb
10. Bob Collins
11. Steve Cook
12. Cliff Crowley
13. George Smith
14. Jim Saunders
15. Jim Nelson
16. Dick DeAngelis
17. Doug Davis
18. Jeff Brown
19. Jim Downing
20. Lee Kelley
21. Andy Brewington
22. Ray Brown
23. Pete Connors
24. Jack Warrelmann
25. Max Nuesia
26. Bob Webster
27. Dee Letterman
28. Dave Bakeman
29. Capt. Gordon Mackie
30. Vince Zegowitz

PMO Conference A Big Success

The annual PMO meeting convened in Seattle, WA at 9:00 a.m. Tuesday, September 25, and ran until mid-day on Friday, September 28. All NWS PMO's (17), regional marine focal points (6), the Marine Observations Program Leader, the VOS Program Manager, and the editor of the MWL were present. We were also privileged to have Captain Gordon Mackie, the British Marine Superintendent, Mr. Ron Fordyce, the Canadian Toronto PMO, Mr. Doug Hess, the Chief of the NWS Headquarters Systems Integration Division, and Mr. Jeff Bowman, a North Atlantic Forecaster at the NWS National Meteorological Center. The conference consisted of discussions and review about procedures and data requirements. All PMO's made presentations about their local port operations. Captain Mackie also gave a very informative presentation about the British program. There were many training and coordination sessions, and ample "hands on" time was devoted to our new computer information and data management system. By unanimous agreement however, the highlight of the meeting was a guided tour of the Redhook brewery, a highly rated local establishment. AMPLE quantities of the various brews were consumed before, during, and after the tour.



New Recruits

Jack Warrelmann, PMO in Newark, presents several plaques to new vessels entering the VOS program as our way of saying thanks. At left is Capt K.E. Sylvestersen of the Marie Maersk and Capt.Hans Katz of the Zim America is to the right. Capt. Cornelius V. Spillane of the Cornhusker State, can be seen at bottom left, while at bottom right is Capt. Frank N. Bjerg of the Arthur Maersk.

Summary of Selected, Supplementary and Auxilary Ships in WMO Voluntary Observing Scheme

Country	Selected Ships		Supplementary Ships		Auxilary Ships	Country totals
	Merchant	Trawlers	Merchant	Trawlers		
Argentina	60		15			75
Australia	82		11		4	97
Bangledesh	9		2			11
Belgium	66					66
Brazil	8		183		154	345
Bulgaria	6		28			34
Canada	140				361	501
Chile	2					2
China	40					40
Cuba	4					4
Denmark	19		4		30	53
Finland			13			13
France	160					160
Germany	492	31	41	2	33	599
Greece	2				24	26
Hong Kong	71		22		1	94
Iceland			32		21	53
India	17		174		35	226
Indonesia			14		16	30
Ireland	7					7
Israel	38					38
Italy	13					13
Jamaica	1					1
Japan	133		65		1	199
Kenya			1			1
Malaysia	34		14		16	64
Netherlands	140		139			279
New Caledonia	1					1
New Zealand	38		3		12	53
Norway	32					32
Pakistan	9		2		5	16
Philippines	34		8		7	49
Poland	99		66		78	243
Portugal	18					18
Rep. Korea			67			67
Saudi Arabia	15		83		2	100
Singapore	47					47
South Africa	37					37
Spain	47				6	53
Sri Lanka	14					14
Sweden	38				36	74
Switzerland	7		1			8
Tanzania	4		3		14	21
Thailand	4					4
USSR	1678					1678
UK, N. Ire.	439	6	5	1	1	452
USA	427		354		569	1350
Yugoslavia	95		83			178

October on Georges Bank

Lt. Craig N. Mclean
National Marine Fisheries Service

In October of 1988 Lt Craig Mclean of the NOAA Corps, Executive Officer aboard the ***Albatross IV***, found himself in an extratropical storm. He had the opportunity to take these photographs of the ***Delaware II***, a companion NOAA ship, which was also riding out the storm. Winds blew at 40 to 50 knots in 20–foot seas. Both vessels were out of Woods Hole NMFS Laboratory.

Coast Guard Portsmouth

U.S. Coast Guard Communication Station Portsmouth/NMN, Selcall 1097, has shifted to an automated HF radiotelex (SITOR) system as of May 1, 1990. This system is designed to speed reception and delivery of AMVER, weather observations and other messages to the U.S. Coast Guard.

NMN radiotelex channels (see revised entries under Atlantic Communications Charts) are being used for testing of the automated radiotelex system. The available commands are listed below with explanation and NMN response:

COMMAND	EXPLANATION	NMN RESPONSE
OBS+	Weather Observation	NOM11+ MSG+
AMV+	AMVER Message	MOM01+ MSG+
MED+	Medical Emergencies	MOM07+ MSG+
URG+	Shipboard Distress/Emergency	MOM20+ MSG+
OPR+	Operator Assistance	
HELP+	List of Available Commands	

After you have typed NMN Selcall 1097 you will receive GA+. Enter a command from the above list and wait for the proper NMN response as indicated. Send your traffic, followed by 4 K's at the end. The 4K's will allow the automated radiotelex to acknowledge your traffic. The acknowledgement will be time, ship selcall/call sign, and duration. Then you will receive GA+ again for any additional traffic. There are no charges for the command services listed. If you have any problems or questions, request operator assistance (OPR+).

Navtex Hawaii

The U.S. Coast Guard broadcasts maritime safety information, including weather forecasts and navigational warnings, over Navtex from Hawaii (NMO) and Guam (NRV) on a trial operational basis. The Navtex identifier for Hawaii is "O", with a broadcast schedule of 0040, 0640, 1240 and 1840 UTC. The Navtex service radius is approximately 200 nautical miles off Honolulu, and 300 to 400 nautical miles from Guam. Comments regarding this service should be directed to Commandant (G–TTS–3), U.S. Coast Guard, Washington, D.C. 20593–0001

Broadcast Schedule

The 1989 edition of *Selected Worldwide Marine Weather Broadcasts* is now available. For vessels in the Voluntary Observing Ship Program of the U.S. National Weather Service, a free copy may be obtained from Port Meteorological Officers located in selected ports in the United States and the United Kingdom. Others may order from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at a cost of $9 U.S. The stock number is 003–017–00534–8. Changes or corrections to the publication should be sent to National Weather Service, International Telecommunications Section, Mail Stop W/020151 1325 East West Highway, Silver Spring, MD 20910

Canberra Change

To align with the Global Maritime Distress and Safety System (GMDSS), the Federal Sea Safety Center, Canberra, Australia, changed its signal address. It is now MRCC (Maritime Rescue Coordination Center) Australia, as of 010001 UTC August 90. Contact numbers and functions at the safety center remain unchanged.

(These little jewels of information appeared in the last issue of the AMVER Bulletin.)

DARWIN, AUSTRALIA

CALL SIGN	FREQUENCIES	TIMES	EMISSION	POWER
AX132	5755 kHz	1100-2300	F3C	10 KVV
AX133	7535 kHz	1100-2300	F3C	10 KVV
AX134	10555 kHz	0000-2359	F3C	10 KVV
AX135	15615 kHz	2300-1100	F3C	10 KVV
AX137	18060 kHz	2300-1100	F3C	10 KVV

TRANS TIME	CONTENTS OFTRANSMISSION TIME AREA	RPM/IOC VALID MAP		
0000/ ~	RECOMMENDED FREQUENCIES FOR AXI RECEPTION	120/576		
0030/ ~	FAX SCHEDULE	120/576		
0200/1400	CURRENT WARNINGS SUMMARY IN PLAIN LANGUAGE	120/576		H
0215/1430	SURFACE ANAL	120/576	00/12	AUST
0330/1530	18HR SIGNIFICANT WEATHER PROG	120/576	18/06	D
0415/ ~	24HR SURFACE PROG	120/576	00/—	AUST
0605/1745	GRADIENTLEVELWINDANAL	120/576	00/12	E
0700/ ~	MEAN SEA LEVEL PRESSURE ANAL	120/576	0000	A + B
0800/1955	500MB STREAMLINE ANA	120/576	00/12	C
0820/ ~	CURRENT WARNINGS SUMMARY IN PLAIN LANGUAGE	120/576		H
0830/2030	ASIAN 24HR 250MB HT/WIND/TEMP PROG	120/576	00/12	ASIA
/2045	CURRENT WARNINGS SUMMARY IN PLAIN LANGUAGE	120/576		H
0905/2100	250MB STREAMLINE ANAL 120/576	00/12		C
0930/2130	18HR SIGNIFICANT WEATHER PROG	120/576	00/12	ASIA
1000/2200	ASIAN 36HR 250MB HTANIND/TEMP PROG	120/576	06/18	ASIA
1045/2220	700MB STREAMLINE ANAL 120/576	00/12		C
1115/ ~	SEA SURFACE TEMP ANAL (TUE ONLY)	120/576		E

NOTES: 1. CURRENT WARNING SUMMARY IS IN PLAIN LANGUAGE AND COVERS FROM 25N-25S, 80E-180
2. NORMAL RECEPTION AREA IS 25N-25S, 75E-180.

MAP AREAS: A	35N- 35S, 130E-180
B	30N- 35S, 075E-130E
C	35N- 35S, 075E-180
D	43S 110E, 36S 155E, 36N 142E, 29N 096E
E	23N- 23S, 1 OOE- 1 70E
H	25N- 25S, 080E-180
AUST-	10S O90E, 50S 080E, 10S 170E, 50S 180
ASIA -	45N - 50S, 1OOE - 180

(INFORMATION DATED 01/1990)

MELBOURNE, AUSTRALIA

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
AXM 31	2628 kHz	(4)	F3C	5 KW
AXM 32	5100 kHz	CONTINUOUS	F3C	5 KW
AXM 34	11030 kHz	CONTINUOUS	F3C	5 KW
AXM 35	13920 kHz	CONTINUOUS	F3C	5 KW
AXM 37	19690 kHz	CONTINUOUS (5)	F3C	5 KW

TRANS TIME	CONTENTS OF TRANSMISSION TIME AREA	RPM/IOC VALID MAP		
0000/1200	36HR SURFACE PROG	120/576	00/12	AUST
0030/ ~	AMENDED REGIONAL SIGNIFICANT WEATHER PROG	120/576	0600	RSW
/1230	500MB ANAL	120/576	0000	SH
0045/ ~	24HR SURFACE PROG	120/576	0000	AUST
/1300	36HR SURFACE PROG	120/576	1200	IO
0115/ ~	FACSIMILE SCHEDULE	120/576		
0130/ ~	IPS RECOMMENDED FREQUENCIES FOR AXM RECEPTION	120/576		
/1345	ANTARCTIC SUPPORT CHARTS	120/576		
0200/ ~	GMS NEPHANALYSIS	120/576	0000	
0215/1430	MEAN SEA LEVEL ANAL	120/576	00/12	AUST
0300/1500	500MB ANAL	120/576	00/12	AUST

(CHG #6 10/1990)

MELBOURNE, AUSTRALIA

TRANS TIME	CONTENTS OFTRANSMISSION	RPM/IOC VALID	MAP TIME	AREA
0315/----	250MB ANAL	120/5761	0000	AUST
----/1515	24HR MEAN SEA LEVEL PROG	120/576	1200	AUST
0330/1530	18HR SIGNIFICANTWEATHER PROG	120/576	18/06	D
0345/1545	18HR REGIONAL SIGNIFICANT WEATHER PROG	120/576	18/06	RSW
0400/1600	24HR 500MB PROG	120/576	00/12	AUST
0415/1615	24HR MEAN SEA LEVEL PROG	120/576	00/12	AUST
----/1715	250MB ANAL	120/576	1200	AUST
0530/1730	24HR 250MB PROG	120/576	00/12	AUST
0545/----	MAX WIND/TROPOPAUSE ANAL	120/576	0000	AUST
0605/1745	GRADIENTLEVELWINDANAL	120/576	00/12	E
0615/1830	1 2HR AMENDED SIGNIFICANT WEATHER PROG	120/576	12/00	RSW
0645/----	ANTARCTIC SUPPORT CHARTS	120/576		
0715/1915	INDIAN OCEAN MEAN SEA LEVEL ANAL	120/576	00/12	10
0730/1930	24HR WIND WAVE HT (M) PROG	120/576	0000	AUST
0745/1945	24HR SWELLWAVE HT (M) PROG	120/576	0000	AUST
0800/2000	SOUTH PACIFIC OCEA~I MEAN SEA LEVELANAL	120/576	00/12	SWP
0815/2015	MEAN SEA LEVEL ANAL	120/576	06/18	AUST
0830/2030	24HR ASIAN 250MB HT/WIND/TEMP PROG	120/576	00/12	ASIAN
0845/2045	24HR INDIAN 250MB HT/WIND/TEMP PROG	120/576	00/12	INDIAN
0915/----	18HR REGIONAL SIGNIFICANT WEATHER PROG	120/576	00/12	RSW
----/2115	30HR INDIAN 250MB HT/WIND/TEMP PROG	120/576	1800	INDIAN
0930/2130	18HR SIGNIFICANTWEATHER PROG	120/576	12/00	D
0945/----	SOUTH PACIFIC OCEAN 36HR 250MB PROG	120/576	1200	SWP
----/2145	1 8HR REGIONAL SIGNIFICANT WEATHER PROG	120/576	1200	RSW
1000/2200	30HR ASIAN 250MB HT/WIND/TEMP PROG	120/576	06/18	ASIAN
1015/----	30HR INDIAN 250MB HT/WIND/TEMP PROG	120/576	0600	INDIAN
----/2215	SOUTHERN HEMISPHERE MEAN SEA LEVEL ANAL	120/576	1200	SH
1030/----	48HR SOUTHERN HEMISPHERE 500MB PROG	120/576	0000	SH
----/2230	36HR SOUTH PACIFIC OCEAN 250MB PROG	120/576	0000	SWP
1045/----	48HR SOUTHERN HEMISPHERE MEAN SEA LEVEL PROG	120/576	0000	SH
----/2245	36HR SOUTHERN HEMISPHERE 500MB PROG	120/576	1200	SH
1100/----	SOUTHERN HEMISPHERE MEAN SEA LEVEL ANAL	120/576	0000	SH
----/2300	48HR SOUTHERN HEMISPHERE MEAN SEA LEVEL PROG	120/576	1200	SH
1115/----	WEEKLY MEAN SST ANAL (TUE)	120/576	----	E
	SST ANAL & 250M TEMP ANAL OF SE AUSTRALIA (THU)	120/576	----	SEAUST
	ICE BOUNDRY (SAT - DURING SUMMER ONLY)	120/576	----	ICE
1130/----	12HRAMENDEDSIGNIFICANTWEATHER PROG	120/576	1800	RSW
----/2330	SOUTHERN HEMISPHERE 500MB ANAL	120/576	1200	SH
1145/----	36HR SOUTHERN HEMISPHERE COMBINED WAVE HT PROG	120/576	1200	SH
----/2345	48HR INDIAN OCEAN MEAN SEA LEVEL PROG	120/576	1200	10

NOTES:
1. RECEPTION AREA IS SOUTHWARDS OF 10N, BETWEEN 70E & 150W.
2 AS AVAILABLE, SUMMER ONLY
3 TRANSMITTED FROM CANBERRA VIA RMF TRANSMITTERS.
4. MAY-JULY 1100-2100, AUG-OCT 1700-2000
5. TRANSMISSION SUSPENDED FOR THE MONTHS AND TIMES IN NOTE #4.

MAP AREAS: AUST -10S O90E, 10S 170E, 50S 080E,50S 180
RSW - O - 50S, 1OOE -180
ASIAN- 1:35,000,000 45N -50S, 1OOE - 180
INDIAN- 1:35,000,000 45N- 50S, 030E -110E
IO - 1:40,000,000 10S-90S, 000-O90 -180
SWP - 1:40,000,000 20S-90S, 150E-180-90W
SH - 1:60,000,000 1OS-90S, ALL LONGITUDES
SEAUST- 31S-40, 148E-156E
ICE - 50S-90S, 005E -175E

(INFORMATION DATED 01/1990)

HALIFAX, NOVA SCOTIA, CANADA

CALLSIGN	FREQUENCIES	TIMES	EMISSION	POWER
CFH	122.5 kHzCONTINUOUS	F3C		
	4271 kHzCONTINUOUS	F3C		
	6330 kHzCONTINUOUS	F3C		
	10536 kHzCONTINUOUS	F3C		
	13510 kHzCONTINUOUS	F3C		

TRANS TIME	CONTENTS OFTRANSMISSION	RPM/IOC	VALID MAP		
				TIME	AREA
0001/1201	SIGNIFICANTWEATHER DEPICTION	120/576		12/00	
0015/----	ICE CHART	120/576		LATEST	
0101/----	30HR/36HR 850MB HT/TEMP/WIND PROGS			120/576	18/00
/1301	ICE CHART	120/576		LATEST	
/1401	ICE CHART	120/576		LATEST	
/1423	1 8HR/24HR 850MB HT/TEMP/WIND PROGS			120/576	06/12
0301/1501	500MB ANALYSIS			120/576	00/12
0315/1515	SURFACE ANALYSIS			120/576	00/12
0401/1601	WAVE ANALYSIS			120/576	00/12
0414/1614	12HR SIGNIFICANT WAVE PROG	120/576		12/00	
0428/1628	850MB ANALYSIS			120/576	00/12
0501/1701	24HR SURFACE PROG			120/576	00/12
0514/1714	24HR SIGNIFICANT WAVE PROG	120/576		00/12	
0601/1801	18HR SIGNIFICANTWEATHER DEPICTION PROG			120/576	18/06
0614/1814	36HR SIGNIFICANTWAVE PROG	120/576		12/00	
0701/----	18HR/24HR 850MB HT/TEMP/WIND PROGS			120/576	18/00
----/1901	36HR SURFACE PROG			120/576	0000
0801/----	36HR SURFACE PROG			120/576	1200
----/2001	18HR/24HR 850MB HT/TEMP/WIND PROGS			120/576	06/12
0814/----	NFLD SST (WED&SAT) NS OFA (TUE)	120/576		LATEST	
	NS SST SI)N&THU) NFLD OFA ~MON&FRI)			120/576	LATEST
----/2014	NS SST NFLD SST MON, WED, SAT)	120/576		LATEST	
0901/----	SURFAC- ANALYSIS			120/576	0600
----/2101	NS OFA (NFLD OFA MON, WED, SAT)	120/576		LATEST	
----/2120	SURFACE ANAL			120/576	1800
1001/----	36HR SURFACE PROG			120/576	1200
----/2201	ICE CHART	120/576		LATEST	
1014/----	BROADCAST SCHEDULE			120/576	
	TEST CHART (TUE-THU-SAT)	120/576			
1101/2301	ICE CHART	120/576		LATEST	

(INFORMATION DATED 03/1990)

ESQUIMALT, BRITISH COLUMBIA, CANADA

CALL SIGN	FREQUENCIES	TIMES	EMISSION	POWER
CKN	4266.1 kHz	CONTINUOUS	F3C	10 KW
	6454.1 kHz	CONTINUOUS	F3C	10 KW
	12751.1 kHz	CONTINUOUS	F3C	10 KW

TRANS TIME	CONTENTS OFTRANSMISSION		RPM/IOC VALID TIME	AREA	MAP
----/1230	TEST CHART		120/576		
----/1235	18HR SURFACE PROG	120/576	0000	A	
----/1245	24HR SURFACE PROG	120/576	1200	A	
0245/----	BROADCAST SCHEDULE	120/576			
----/1515	TEST CHART	120/576			
0300/1520	COMBINED 850MB/500MB ANAL		120/576	00/12	C
0310/1530	SURFACE ANAL	120/576	00/12	A	
0320/----	12HR WX DEPICTION PROG		120/576	1200	A
----/2115	TEST CHART	120/576			
----/2120	06HR SIGNIFICANT WEATHER PROG		120/576	0000	A
----/2130	1 8HR SIGNIFICANT WEATHER PROG		120/576	1200	A
----/2140	1 8HR SURFACE PROG	120/576	1200	A	
----/2150	30HR SURFACE PROG	120/576	0000	A	
1030/2200	SURFACE ANAL		120/576	06/18	A
1040/2210	18HR WAVE HT PROG	120/576	00/12	A	
----/2220	30HR WAVE HT PROG	120/576	0000	A	
----/2230	SEA SURFACE TEMP ANAL (TUE & FRI)		120/576		B
	OCEAN ANAL CHART (MON & SAT)		120/576		B
1050/----	30HR WAVE HT ANAL	120/576	1200	A	
1100/----	06HR WEATHER DEPICTION PROG		120/576	1800	A
1110/----	1 8HR WEATHER DEPICTION PROG		120/576	0600	A

NOTES: 1 . EACH TRANSMISSION PERIOD IS PRECEDED BY 2 MINUTES OF PHASE WHITE SIGNAL THEREAFTER CHARTS FOLLOW ONE AFTER ANOTHER WITHOUT A PHASE PERIOD.

AREAS: A - 58N 173E, 38N 160W, 36N 119W, 54N 103W
B - 46N 177W, 28N 157W, 37N 122W, 63N 121W
C - 68N 170W, 34N 160W, 27N 124W, 50N 096W

(INFORMATION DATED 06/1990)

ROTA, SPAIN

CALLSIGN	FREQUENCIES	TIMES	EMISSION	POWER
AOK	4704 kHz &~	1800-0600	F3C	
	5785 kHz &	CONTINUOUS	F3C	
	9050 kHz $~	CONTINUOUS	F3C	
	9382.5 kHz &~	CONTINUOUS	F3C	
	9875 kHz &	ON REQUEST	F3C	
	17040 kHz $~	CONTINUOUS	F3C	
	17585 kHz &~	0600-1800	F3C	

(&) SPAIN FREQUENCIES ($)ITALY FREQUENCIES

TRANS TIME	CONTENTS OFTRANSMISSION	RPM/IOC	VALID TIME	MAP AREA
------/1203	72HR SURFACE PRESSURE/WIND PROG	120/576	---/00	
0017/1217	24HR THICKNESS PROG	120/576	00/12	
0031/------	MFAX BROADCAST SCHEDULE	120/576	---/---	
------/1231	72HR 500MB PROG	120/576	00/---	
0045/------	MFAX BROADCAST SCHEDULE (CONTD)	120/576	---/---	
------/1245	ECMF 48HR SURFACE PRES PROG	120/576	---/12	
0059/------	OPEN	120/576	---/12	
------/1259	ECMF 48HR 500MB HT PROG	120/576	---/12	
0113/1313	MIDEAST SURFACE PRES/WIND ANAL	120/576	12/00	
0127/1327	MIDEAST 36HR SURFACE PRES/WIND PROG	120/576	00/12	
0141/1341	MIDEAST 500MB HT/TEMP/WIND ANAL	120/576	12/00	
0155/1355	MIDEAST 36HR 500MB HT/TEMP/WIND PROG	120/576	00/12	
0209/1409	MIDEAST 36HR 250MB HT/TEMP/WIND PROG	120/576	00/12	
0223/------	WEST MED SST ANAL	120/576	00/---	
------/1423	ECMF 96HR SURFACE PRES PROG	120/576	---/12	
0237/------	EAST MED SST ANAL	120/576-	---/12	
------/1437	ECMF 96HR 500MB HT PROG	120/576	---/12	
0251/1451	PRELIM SURFACE ANAL (1)	120/576	00/12	
0305/------	OPEN			
------/1505	ECMF 1 20HR 500MB HT PROG	120/576	----/12	
0321/------	EAST MED SATELLITE IMAGERY	120/576	---/---	
------/1521	ECMF 1 20HR 500MB HT PROG	120/576	---/12	
0335/------	WEST MED SATELLITE IMAGERY	120/576	---/---	
------/1535	SATELLITE IMAGERY	120/576	---/---	
0349/1549	FSME LERT RETRANSMISSION	120/576	00/12	
0403/1603	NORAPS SURFACE PRESS ANAL	120/576	00/12	
0417/1617	NORAPS 500MB ANAL	120/576	00/12	
0431/1631	NORAPS 36HR SURFACE PRES PROG	120/576	00/12	
0445/1645	NORAPS 36HR 500MB PROG	120/576	00/12	
0459/1659	NORAPS 48HR SURFACE PROG	120/576	00/12	
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0527/1727	500MB HT/TEMP/WIND ANAL	120/576	00/12	
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0555/1755	TEST CHART	120/576	---/---	
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0637/1837	925MB HT/TEMP/WIND ANAL	120/576	00/12	
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0705/1905	24HR SURFACE PRES/WIND PROG	120/576	00/12	
0710/1919	24HR 500MB HT/TEMP/WIND PROG	120/576	00/12	
0733/1933	24HR 850MB HT/TEMP/WIND PROG	120/576	00/12	
0747/1947	24HR 250MB HT/ISOTACH/WIND PROG	120/576	00/12	
0801/2001	24HR 400MB HT/TEMP/WIND PROG	120/576	00/12	
0815/2015	24HR 925MB HT/TEMP/WIND PROG	120/576	00/12	
0829/2029	24HR 700MB HT/TEMP/WIND PROG	120/576	00/12	
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0911/2111	36HR 850MB HT/TEMP~WIND PROG	120/576	12/00	
0925/2125	36HR 500MB HT/TEMP/WIND PROG	120/576	12/00	
0939/2139	36HR 700MB HT/TEMP/WIND PROG	120/576	12/00	
0953/2153	36HR 250MB HT/ISOTACH/WIND PROG	120/576	12/00	
1007/2207	SURFACE PRES PRELIM ANAL (1)	120/576	06/18	
1021/2221	36HR SURFACE PRES/WIND PROG (FSME LERT)	120/576	12/00	
1035/2235	SATELLITE IMAGERY	120/576	12/00	
1049/2249	36HR SIGNIFICANT WAVE PROG (OSME LERT)	120/576	12/00	
1103/------	36HR NATL SURFACE PROG	120/576	12/00	
------/2305	GG THETA ANAL	120/576	----/12	
1049/2249	36HR SIGNIFICANT WAVE PROG (OSME LERT)	120/576	12/00	
1103/------	36HR NATL SURFACE PROG	120/576	12/00	
------/2305	GG THETA ANAL	120/576	----/12	
1119/2319	36HR 500MB SD/SR LONGWAVE PROG	120/576	00/12	
1135/2335	48HR SURFACE PRES/WIND PROG	120/576	00/12	
1149/2349	48HR 500MB HT/TEMP/WIND PROG	120/576	00/12	

NOTES: 1. ISOBAR SEPARATION 4MB IN WINTER, 2MB IN SUMMER.
2. CHANGES IN THIS BROADCAST ARE DICTATED BY THE NEEDS OF THE UNITED STATES NAVY.
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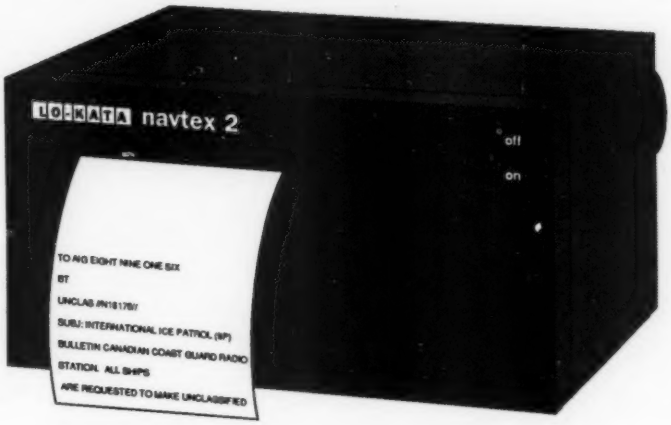

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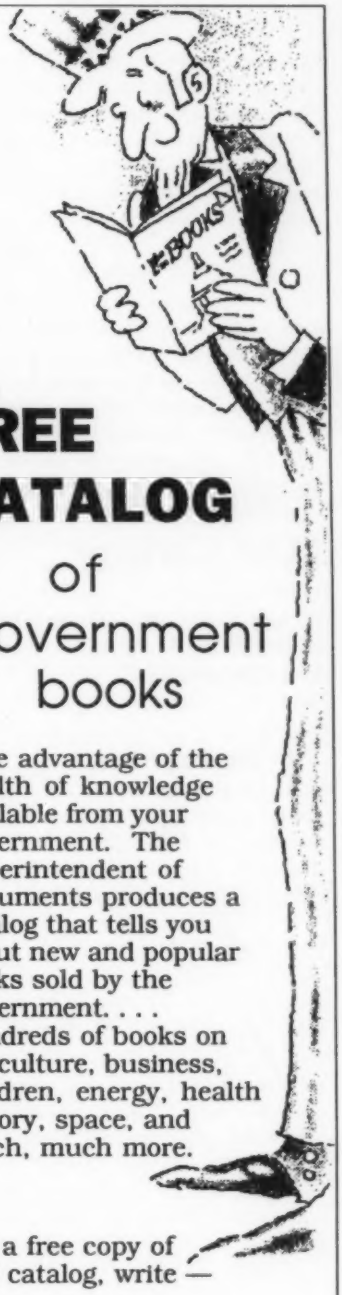

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Sinking of the M/V *Corazon*

Lionel Bryant
U.S. Coast Guard

Twenty–seven crewmen of the Greek ***M/V Corazon*** were forced to abandon ship after a 12–hour ordeal involving Hurricane Bertha in the North Atlantic in late July. Through a combined international effort, 21 crewmen were saved.

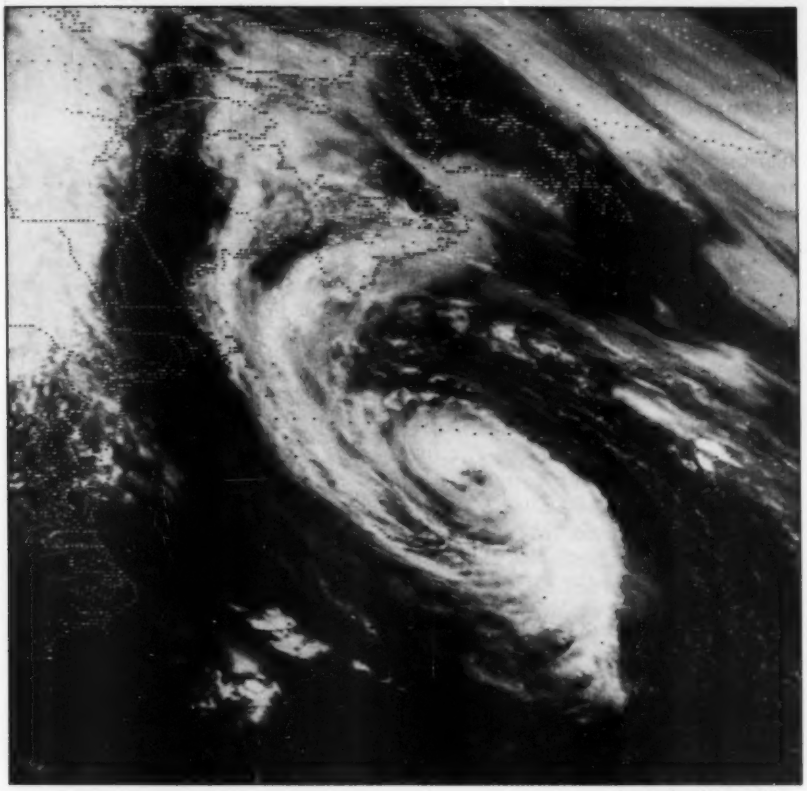
At about 3 p.m. on the 31st of July, the Canadian Coast Guard received a mayday call from the vessel, some 350 miles southeast of Cape Cod, MA. The Captain of the 593–foot ship reported that the ***Corazon*** had ***"broken its back,"*** and they were preparing to abandon ship. The Canadian Coast Guard informed the U.S. Coast Guard Atlantic Operations Center, in New York City, which coordinated the case and maintained communications with the ship via aircraft throughout the long night.

First on the scene was a Coast Guard Falcon followed by a Coast Guard C–130 along with two Air Force C–130s. Four merchant ships were located in the vicinity of the Corazon by the Operations Computer Center on Governors Island, NY, through the use of **AMVER** (Automated Mutual–Assistance Vessel Rescue System). These vessels, of various flags, were requested to assist the crippled ship. The aircraft observed that the ***Corazon*** had broken her keel and had lost steerage. The broken keel caused the ship to buckle in the middle, raising its stern out of water. The heavy seas generated by Hurricane Bertha pounded the vessel, increasing its chances of sinking. Because of the 20– to 30–foot seas and 80–knot wind gusts, the Corazon's crew had not yet attempted to get into the liferafts.

At about 10:30 p.m., the Liberian–registered vessel ***Hual Angelita*** arrived on the scene and forwarded reports from the stricken vessel that its bow was partially sheared off. At 2 a.m. on the 1st of August the eye of Hurricane Bertha was estimated about 55 miles from the vessel. The ***Corazon*** rode out the hurricane until 4:45 a.m., when the crew was forced to abandon ship. In liferafts, they began to row away from the sinking vessel. It was reported that at least one crewman is in the water and a Soviet fishing vessel was trying to render assistance, while a Soviet merchant vessel was going after the liferaft. As the crew entered the liferafts, the eye of Hurricane Bertha was passing over them. This proved to be the best time for rescue vessels to attempt to bring survivors aboard their ships.

By 2 p.m., 24 people were onboard the M/V ***Leonid Leonidov***. Of these, three were dead and one was injured. The remaining people were in good condition. Later that afternoon, the final three bodies were discovered in the water. Recovery of these bodies was impossible due to deteriorating weather and sea conditions.

The ***Leonid Leonidov*** sailed to Portland, ME, and moored at Merrill Marine Terminal. The ***Corazon*** survivors and the remains of the deceased were returned home.



Satellite Data Services Division

This satellite view of Hurricane Bertha was taken on the 31st of July at about the time the Corazon was beginning to encounter difficulties.

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AMVER News

Richard T. (Rick) Kenney recently joined the AMVER staff in Governors Island, New York City. Mr. Kenney will direct marketing efforts to expand worldwide merchant fleet participation in the Coast Guard's Automated Mutual Assistance Vessel Rescue Program.

Mr. Kenney is a native of Brooklyn, NY with degrees from St. John's University and Brooklyn College. His past involvement in the maritime community was as Legislative and Public Affairs Officer for the U.S. Navy's Military Sealift Command, Atlantic in Bayonne, NJ. He also served as civilian personnel manager for such Navy activities as Supervisor of Shipbuilding, Conversion and Repair in Brooklyn and the Strategic Systems Program Office. "I'm looking forward to renewing old acquaintances in the maritime industry. I had to get out from behind a desk and back to the operating environment. I miss my ships and the camaraderie of the close-knit maritime community,." Kenney says.

AMVER

The 30-year old AMVER system pioneered the concept of computerized tracking of ships at sea to provide an accurate search and rescue resource for assistance in emergencies. Participation is voluntary and the AMVER program is available to ships of all flags with the single humanitarian purpose of safety of life and property at sea. At no cost, commercial ships report their position to a PRIME 9955 Minicomputer at the Coast Guard's Operations Computer Center on Governors Island. Upon notification of a vessel in distress, the computer is queried to identify AMVER ships in the area which could be directed to assist. Annual awards recognize continuous ship participation.

The National Maritime Alliance

In the summer of 1987, the *National Maritime Historical Society* proposed establishment of a maritime alliance; "an alliance of all who share the values and traditions of American seafaring to work together for the common good."

Formally organized the following year, the *National Maritime Alliance* is a coalition of maritime museums, professional societies, sea experiences and maritime skills organizations, historical and preservation groups, maritime unions and maritime industry associations, etc. Its principal purpose is to broaden public awareness and appreciation of this nation's great maritime heritage and traditions.

The organizations that make up the Alliance coalesce around shared conclusions concerning such national issues as funding and planning for preservation of historic vessels and maritime structures, development of standards for maritime preservation activities, expansion of opportunities for marine education, and preservation of traditional maritime skills and technology.

Communication, advocacy, and education are the principal areas of Alliance activity.

Communication with and among Alliance member organizations through the publication, *Sea History Gazette*, minutes of board meetings, and occasional notices on issues that are particularly pressing will address a recognized need in the maritime community, which has been notoriously fragmented and parochial.

The Alliance will seek out opportunities to educate the public about maritime history and the role of maritime activity in our culture. This broad effort will involve the media, schools and universities, cultural organizations, and recreation programs, as well as government.

Rafe Parker, Director of Sea Education Association, in Woods Hole, MA, is the Alliance chairman. The Maritime Office for Historic Preservation, in Washington, DC, acts as secretariat for the Alliance. Membership is open to any organization that has an interest in maritime matters. Membership is free to any such organization. For information telephone 202–673–4127.

Sea History Gazette

From preservation of a World War II submarine in Muskogee, Oklahoma to sail training programs in New England; from maritime museums on the Great Lakes to lighthouses in the Pacific Northwest; the scope of maritime heritage activity in the United States is more broad and varied than most of us would imagine. Keeping on top of it all would be a tall order.

One publication that does a great job of helping its readers keep up is the *Sea History Gazette*, a digest of maritime heritage news published by the National Maritime Historical Society. Issued bi–weekly and sent to subscribers by first class mail, the Gazette carries timely notices of people, organizations, publications, events and activities of interest to the maritime world. It has been named the official journal of the Maritime Alliance by the Alliance Board. Subscriptions are $35 per year ($25 for NMHS members). For information on the *Sea History Gazette* or membership in the *National Maritime Historical Society*, write: NMHS, P.O. Box 646, Croton–on–Hudson, NY 10520.

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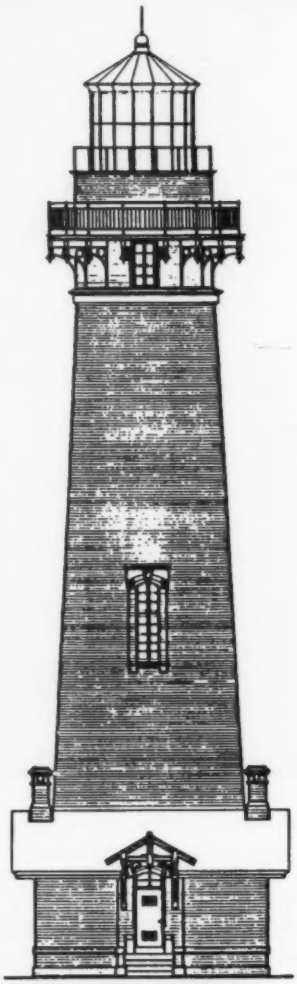

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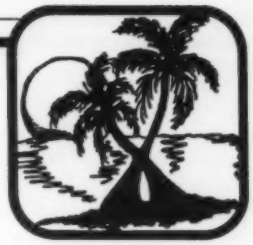


South Pacific Ocean Tropical Cyclones

Staff, Fiji Meteorological Service

Coral Sea Depression

Alipate Waqaicelua

A shallow area of low pressure developed 600 miles northwest of Noumea in a slow–moving trough, at about 0600 UTC on the 20th of January.

Some favorable surface and upper–air conditions aided the system's initial development, and winds around the center gradually increased to just below gale force. However, it later encountered some strong upper level wind shear which retarded further development. In the absence of any major steering flow, this area of low pressure remained slow–moving for almost two and a half days.

As the upper–level trough deepened on the 22d, the system became more organized and gale force winds up to 35 knots were reported within 300 miles of the center in the southern semi–circle.

Steered by the northwesterlies on the downstream side of the upper–trough, the depression moved steadily towards the southeast for the next 30 hours. Gradually, an upper–level anticyclone slipped to the southeast of the depression bringing northeasterlies over the system. This flow re–directed the depression towards the southwest and accelerated it to over 20 knots. After 1200 UTC on the 24th, the system, while still maintaining gale intensity, entered Wellington's area of responsibility for issuing marine warnings.

This depression spent most of its lifespan over water except when it passed close to New Caledonia on the 24th. However, no reports of damage were reported from New Caledonia. This was largely due to the small and not–so–intense nature of the system.

Tropical Cyclone Peni

Sudha Pandaram

A shallow area of low pressure developed close to Rakahanga, in the Northern Cooks, along the South Pacific Convergence Zone. It was first detected on the 12th of February 1990. By the 13th it was evident that there were two very small centers in the system, with the major one lying close to Rakahanga.

After remaining separate for about 24 hours, the two centers gradually merged into one and gale force winds were forecast to develop around this new center. During the 13th of February, the system developed some tropical cyclone characteristics and winds close to center were expected to increase further. The system was then named Tropical Cyclone Peni at 2100 UTC on the 13th. Immediately after its naming, Peni was upgraded to storm intensity with average winds estimated at 50 knots close to the center.

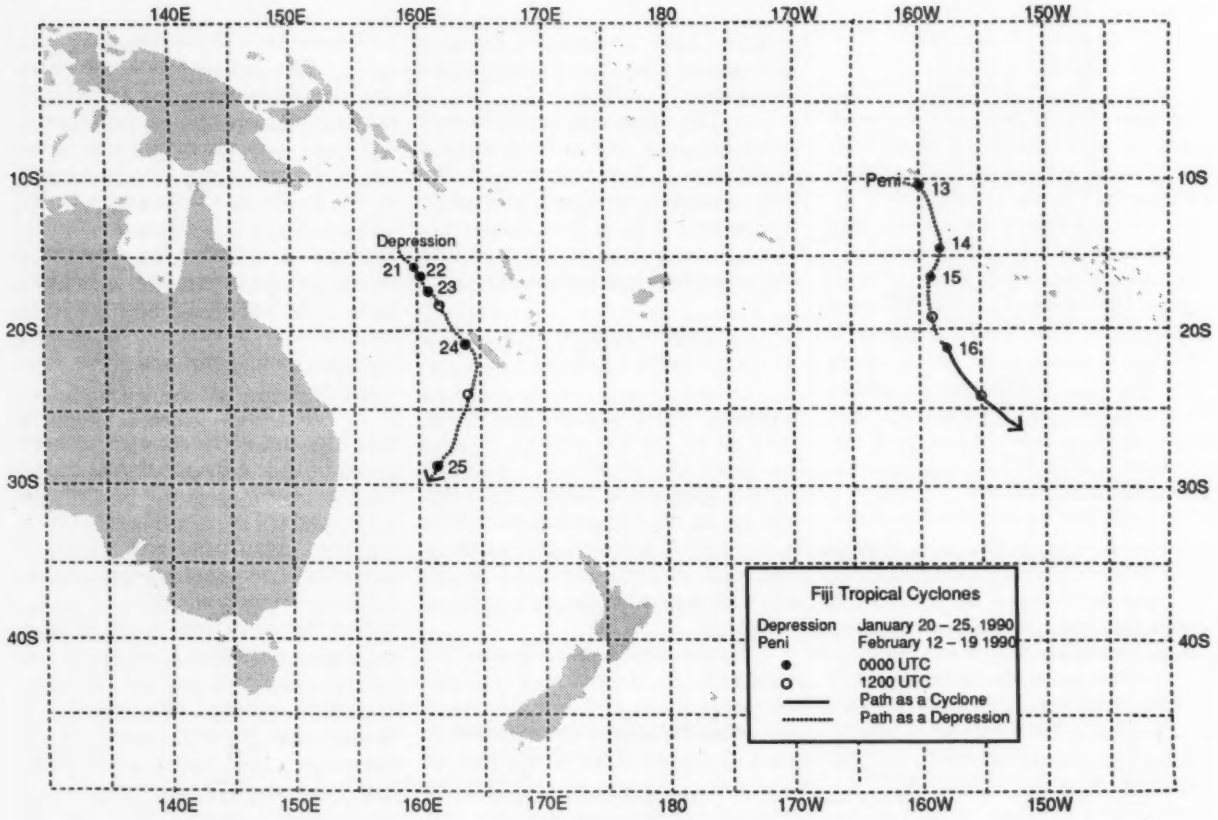
The cyclone followed a steady south southwest path over the next 30 hours, while continuing to intensify, and then gradually curved toward the south. It passed very close to Aitutaki in the Southern Cooks around 1000 UTC on the 15th. By then, the Aitutaki Meteorological Office was abandoned due to deteriorating weather conditions. The barometer and the barograph were re–located in a village away from the main office and winds were only estimated.

As Peni passed close to Aitutaki, the blocking area of high pressure to the far southwest of the Southern Cooks caused it to gradually curve toward the southeast. With improved organization and reports of increasing winds, Peni was upgraded to hurricane intensity at 0600 UTC on the 15th of February, with winds close to the center estimated at 65 knots. As Peni accelerated toward the southeast, it passed between the islands of Mangaia and Mauke. Steered by the strong upper level northwesterly winds, Peni accelerated further towards the southeast and crossed 25°S, around 1200 UTC on the 16th, into Wellington's area of primary responsibility for issuing marine warnings. It maintained hurricane intensity for the next 18 hours and was downgraded to a storm at 0600 UTC on the 17th. Peni

lost its tropical cyclone characteristics about 12 hours later, and from then on it was a depression with storm force winds still close to its center. It rapidly lost its intensity as it moved over cooler waters and encountered strong vertical shear. Although the system lost tropical cyclone characteristics quite early, gales remained associated with it for a considerable period longer.

Peni caused significant damage to some of the islands in the Northern and Southern Cooks while others escaped with only minor effects. In the Northern Cooks, only Rakahanga reported major damage to buildings, crops and trees. In the Southern Cooks, damage of varying degrees was reported from the different coastal areas, with high storm tides the major cause of damage. In Atiu, the school assembly hall collapsed and some houses were damaged. Mauke reported severe damage to its airport, while some warehouses were destroyed and crops damaged. Sea waves there were reported to have reached the highest in memory. Over the rest of islands in the group damage was minimal.

Peni was the first cyclone to affect the Cook Islands so far this year. On the whole it was a fairly well behaved cyclone with a generally smooth track. The system lost its tropical cyclone characteristics relatively early, but maintained gale force winds around the centre for a considerably longer period. Although it passed close to several inhabited islands, its overall effect was moderate.



North Atlantic Weather April, May, and June 1990

April— The big climatic news for this month was a large 1028–mb Azores–Bermuda High centered just north of the Azores (fig 1). This resulted in pressure anomalies of up to +10mb in this region; for the most part, anomalies were positive south of 60°N. The Icelandic Low was more of a trough of low pressure, although a broad 1002–mb center stretched from Iceland to the North Pole. The storm track chart reflects this climatic situation. The upper steering levels indicate a general flow toward the east northeast with the indication of a ridge over the Azores.

On This Date

April 26, 1898— The three–masted schooner ***George L. Fessenden*** sailed from Philadelphia for Southport with 521 tons of stone. She ran into a strong southeast gale near Cape Lookout, turned back to just north of Cape Hatteras and was clobbered by a strong northeaster. By the morning of the 26th, her foremast was broken, her main–topmast was missing, and she had lost most of her sails. She grounded and four of the seven man crew lost their lives. The others were rescued.

Ocean Weather

The month opened with a large double–centered High dominating most of the northern North Atlantic. The strongest, a1037–mb center, was located near 55°N, 35°W. South of 40°N, a couple of Lows were spotted moving past the Azores toward Iberia. By the 3d, a complex low pressure system was developing along the East Coast of the U.S. and soon merged with a Great Lakes Low. However, the storm was forced northward into Quebec on the 4th. Meanwhile a 986–mb storm developed off Iceland and headed southward, while another, east of the Bahamas, moved northeastward. The Icelandic storm made it all the way to the entrance to the Strait of Gibraltar by the 8th, and became the third storm of the month to hit the Iberian Peninsula. At 1200 on the 6th, the ***Gdynski Kosyner***, ***Golden Endeavor***, KGPK, OXMA2, and OVKR reported winds in the 40– to 60–kn range in seas that varied from 5 to 20 ft. These vessels were north of the Azores between a 996–mb Icelandic Low and a 1033–mb High, centered near 40°N, 40°W. This is a good example of how a tight pressure gradient can turn a moderate low into a dangerous storm.

❶ Things were quiet until the 10th. At 1200, several ships in the vicinity of 42°N, 42°W reported 40– to 45–kn winds out of the west through north-

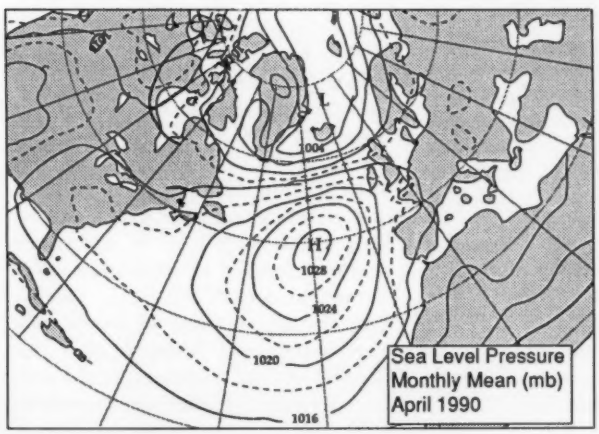


Figure 1.— The Azores–Bermuda High is certainly the dominant feature this month. In general, this type of situation indicates good weather for shipping, which is particluarly important in a volatile month like April. This analysis was provided by Vernon Kousky and John Kopman.

Figure 2.— This visual satellite photograph was taken just after 1200 on the 10th of April. This system was to evolve into a dangerous 956–mb storm the following day. Its frontal system bulges southeastward over Norway and then trails southward all the way into the Bay of Biscay.

west. The ***Incotrans Pacific*** battled 25–ft seas. On the weather charts a two huge 1035–mb Highs dominated the entire North Atlantic south of 50°N. Off Iceland, a 972–mb Low center stalled (fig 2), while a second center approached. This conglomeration evolved into a potent 956–mb storm just northeast of Iceland on the 11th. An increase in gale reports from ships reflected the power of this system in combination with the large Highs to the south. Typical of the reports was that of the ***Hofsjokul*** (62°N, 24°W), which encountered a 44–kn west northwesterly and a 975–mb pressure. The system actually had a double center and dominated the seas south of Iceland through the 12th.

Meanwhile, a Low that had formed west of California, on the 7th, made its way across the U.S. and into the Gulf of Maine by the 11th. Its pressure fell to 989 mb the following day, as it moved through the Gulf of St Lawrence. Bumping against a 1040–mb High to the southeast, it tightened the pressure gradient, which was responsible for gale and storm force winds over the shipping lanes off the Grand Banks. The ***Sedco 710*** (46°N, 49°W) encountered 40– to 45–kn southwest winds in 13–ft seas throughout the 12th. The High pushed eastward as the Low continued northeastward, and the gradient slackened on the 13th. This Low actually became better organized as it moved by Kap Farvel; by the 14th its central pressure had dropped to 968 mb and it gave the appearance of a good winter storm. At 1200 on the 14th, the UFJJ (60°N, 31°W) hit 50–kn westerlies while battling 26–ft seas. In general, this system generated gales, on the 14th, as far south as 45°N, and rough weather extended southeastward to the Norwegian and North Seas. On the 15th, the system made an abrupt turn northward and headed into the Greenland Sea. However, it did continue to generate gales over the north-

ern shipping lanes into the 17th. Great Britain's ***Cumulus*** was a faithful reporter during this storm. For example, at 1800 on the 16th, near 57°N, 20°W, she radioed 45–kn west northwesterlies in 18–ft seas and 30–ft swells— one of several excellent reports. The 1040–mb High stalled near 40°N, 25°W, on the 14th, and continued to dominate a good portion of the central Atlantic for the following week.

The presence of this strong semipermanent Azores High forced cyclonic activity to remain over the western North Atlantic. It was reinforced on the 19th, when a large High from the southeastern U.S. moved off the coast. Several minor Lows were able to penetrate the edges of these systems, but conditions were relatively quiet until the 24th. At this time, several gale reports were associated with a frontal system near 40°N, 40°W. The ***S Kirov, Star Evviva, Valdivia,*** and the ***Saudi Riyadh*** all reported winds in the 40–kn range. This activity was short–lived. Another system to the northeast organized nicely, on the 25th, near Iceland. Its 966–mb center continued on a northeastward heading, so the effects were felt mainly over the Norwegian Sea. At 1200 on the 26th, its 971–mb pressure center was found north of 70°N near the prime meridian.

As the month closed, a 976–mb Low was spotted near 55°N, 35°W. It had intensified from a rather weak 997–mb center some 24 hr before. A few vessels in its vicinity, particularly ahead of the front, encountered gales out of the south and southwest.

Casualties

On the 17th, a severe storm over the South Atlantic caused problems in southern Brazil and Argentina. In the Rio de Janeiro area at least seven people died and 25 were injured by landslides and electrical accidents, resulting from the violent rain and 40–kn winds. Several fishing vessels off Mar de la Plata ran into trouble during the storm. The ***Amapola*** was being towed by the ***Angelito,*** but radio contact with the vessels was lost. Subsequently, the body of one crew member was discovered along with a liferaft and parts of a hull.

A powerful sandstorm on the 24th plunged Egypt into total darkness for more than 2 hr. The strong winds experienced at Hodeidah caused the ***Donetsk*** to drag anchors and collide with the ***Shams Al Basrah.*** In Hodeidah city, trees and factory chimneys were felled. On the 28th, the Mv. ***Elizabeth K.*** grounded, in bad weather in the Baltic, near Gdynia, Poland.

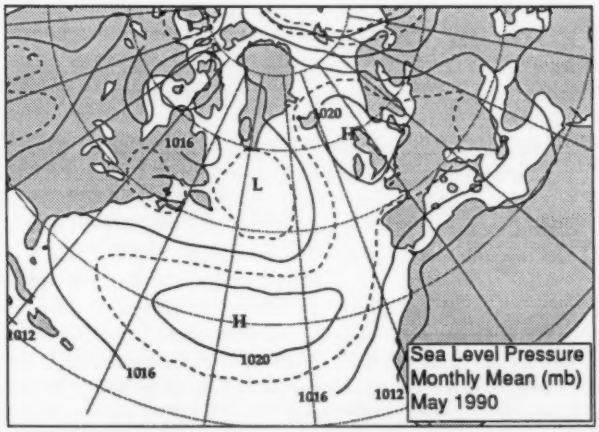


Figure 2.— The Azores–Bermuda High was forced south of its normal position, although it certainly looks like the dominant feature. Notice the high over the British Isles, which resulted in positive anomalies in that region. Chart analysis was provided by Vernon Kousky and John Kopman.

May— The Azores–Bermuda High took its rightful place on the May climatic chart; well, not quite (fig 3). It was forced southward by an area of low pressure south of Greenland while a strong high, centered over the British Isles, extended over western Europe and Scandinavia. Pressure anomalies down to –6mb were centered near 45°N, 40°W, and anomalies up to +8mb were analyzed over the northeastern North Atlantic. In the upper atmosphere, the steering currents were nearly zonal from North America to about 40°W, where they turned toward the northeast. In an ideal situation a New York storm would end up over London.

On This Date

May 18, 1894 – On Lake Michigan the schooner ***Evening Star*** foundered off Twenty–Sixth St. in Chicago, IL during a heavy gale. While no lives were lost the vessel was a total loss.

Ocean Weather

The storm that closed out April, centered near 55°N, 35°W as the month opened, continued to generate 35– to 40–kn winds south and west of its center on the 1st. However, it moved into the Greenland Sea and weakened the following day. A large High settled over northwestern Europe and the British Isles, while another one dominated the central North Atlantic. By the 4th, part of the central North Atlantic High merged with the one over Europe to form a block over the eastern part of the ocean. This forced cyclonic activity farther south than normal, and several smaller Lows could be seen moving along the 40th parallel.

Finally, on the 7th, a 986–mb system moved out of southern New England and across Newfoundland. The GJPP, near 49°N, 42°W at 1200, was rocked by a 55–kn south southeast-

erly. Six hr later, old reliable, the ***Sedco 710*** (46°N, 49°W) reported southwest 42–kn winds in 16–ft seas. The storm and its frontal system continued to create a few problems for shipping as it headed toward Kap Farvel on the 9th.

A wave that had developed along the front of the previous system, merged with a weak Low off Labrador to cause a few problems on the 10th and 11th near mid–ocean. At 1800 on the 10th, the ***Steregushchiy, Hannover, Dugi Ottok, Euro Mexico,*** and the DPNR ran into 40– to 50–kn winds from 39°N to 42°N, between 35° and 40°W. Seas up to 20 ft were reported. These conditions continued on the 11th as the system tracked toward the northeast. After weakening, and swinging southeastward on the 12th, it reintensified slightly by the 14th. By this time, the 986–mb Low was heading for Ireland and oblivion.

On the 15th and 16th, the Atlantic was divided into a series of small Highs and Lows and there was little noticeable pressure gradient. It wasn't until the 18th that a Low, near 40°N, 45°W, intensified enough to briefly generate gale force winds. The LAWO2 and TCQM hit 45– to 48–kn winds near 40°N, 47°W at 1200. However, this storm weakened the following day and the amorphous situation returned. The next week was composed of several rather weak Lows scooting across the Atlantic between a High over Greenland and another south of 30°N.

A complex two–centered Low was analyzed over the northwestern Atlantic on the 26th. Some winds to the south of the southern center reached 30 kn but otherwise there was little to report. By the 27th, it had become a 994–mb single–centered Low northeast of Newfoundland. A large High was building over the southern part of the North Atlantic late in the month, and extended its influence northward. It wasn't until the end of the month that a well organized system showed up.

● This storm originally developed over Arkansas on the 28th. Late the following day, it made an appearance in the North Atlantic, off New Jersey. Moving northeastward, along the northwestern side of the 1030–mb High, it intensified. By 1200 on the 31st, its minimum pressure was estimated at 972 mb in a center over Newfoundland. Several vessels, including the ***Yankee Clipper, Nemirov,*** ULYZ, and the CGDW ran into 40 to 45–kn winds at 0000 on the 31st. At 1200 the C6IZ3 (47°N, 50°W) was clobbered by a 58–kn west southwesterly while the S6HT reported a 50–kn westerly. The C6IZ3 came back with a 60–kn report at 1800 while battling 30–ft seas. Wind reports of 40 to 50 kn continued on the 1st of June, but the system started to weaken. It also turned toward the southeast. However, it did retain its identity until the 30th.

While storm No. 1 was developing, the first tropical depression of the season came to life in the North Atlantic. It begun as a depression over Cuba on the 26th. After swinging across southern Florida and Bahamas it headed northeastward.

Casualties

Flooding from torrential rains in Cuba drowned a 70–yr old man, cut a railway line and forced the evacuation of 6,000 people in central Cuba on the 27th. This was associated with a trough and the first tropical depression of the season.

June— The Azores – Bermuda High was in its glory over the North Atlantic in June (fig 4). It was actually centered just northwest of its normal position, and was a little stronger, resulting in positive anomalies up to 4mb. Anomalies were negative over the northern North Atlantic, as the Icelandic Low showed some influence, particularly between Iceland and Scotland. In the upper atmosphere the steering pattern was practically non–existent south of 40°N, and nearly zonal to the north.

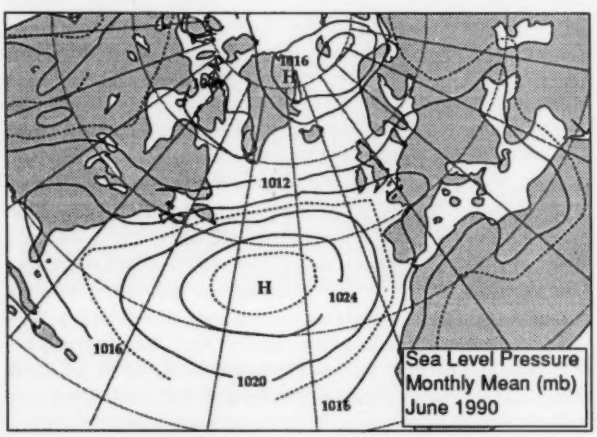


Figure 4.— The Azores–Bermuda High is slightly stronger than normal. Notice a fairly tight pressure gradient to the north of the high, an indication that there could have been some problems over the shipping lanes. Chart provided by Vernon Kousky and John Kopman of the Climate Analysis Center.

On This Date

June 27, 1957— Hurricane Audrey smashed ashore at Cameron, LA drowning 390 people in the storm tide. Audrey caused more than $150 million damage in Texas, Louisiana and Mississippi. Just a brick courthouse and cement block icehouse were left standing at Cameron, LA. The winds and waves of Audrey tossed a 78–ton fishing vessel onto an offshore drilling platform.

Ocean Weather

The month began with a 972–mb storm center left over from May pestering shipping and fishing off the Grand Banks. The GZMM, some 600 mi south of the center, battled 16–ft swells. Several other vessels closer to the center reported gales, while the OVYA hit a 50–kn easterly in 20–ft seas, with a 982–mb pressure, near 59°N, 45°W. However, by the 20th, the system weakened as it approached Kap Farvel. A large 1030–mb High centered itself off the Carolinas and, along with another southwest of the Azores, dominated the weather south of 50°N.

Meanwhile, a Low, which had formed over Canada's northwest territory, moved across Hudson Bay to south of Kap Farvel by the 3d. It didn't amount to much, although its front spawned several weak waves, which followed along to the south. By the 5th, the two Highs merged into one large 1035–mb High centered near 35°N, 35°W. This system persisted for several days and forced a series of small extratropical lows to move to the north and northwest.

On the 10th, one Low moved off the coast of New England, and forced its way into the semipermanent ridge. It broke into several weak low centers on the 12th, and two of these managed to organize. One became a 982–mb Low, on the 14th, south of Iceland, while the other meandered in circles off Cape Hatteras for several days.

❶ The Icelandic center generated gales on the 14th and 15th (fig 5). The ***Cumulus*** (57°N, 21°W) reported 43–kn southeasterlies at 0600 on the 14th and nearby. Seas were running about 16 to 18 ft. The Low stalled on the 15th and remained nearly stationary for several days. Between it and the High to the southwest a gradient was created that generated 20– to 30–kn winds and 10–to 20–ft swells into the 19th.

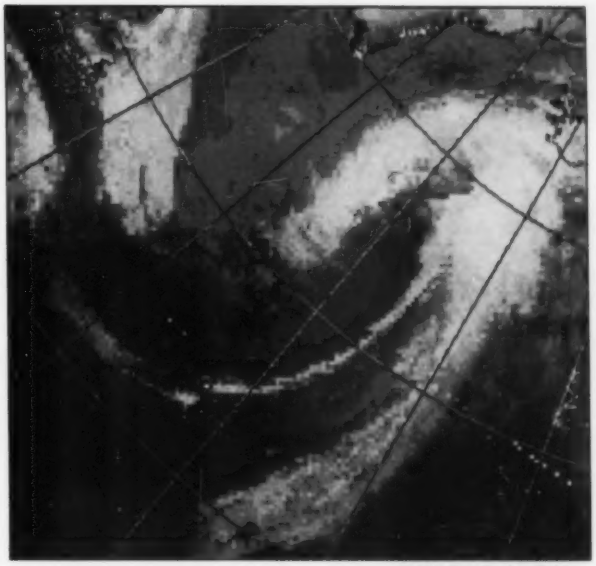


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Figure 5.— This nighttime IR satellite photograph was taken late on the 14th of June. The Low was slowing down and about to stall. The central pressure was about 982 mb, and the front, which can be seen trailing toward the south, actually loops westward into Nova Scotia on the weather charts for the period.

Finally the Low weakened and moved toward the southeast as several other disturbances pushed in to take its place. The 1039–mb High lumbered eastward. Several of the weaker low pressure centers merged on the 21st to form a 990–mb Low over England. Winds over the North Sea were blowing at gale force. The ***Versailles*** (50.5°N 0.3°E) encountered 42–kn southwesterlies at 0000 on the 22d. There were even a few storm force reports by vessels such as the ***Cotinga, Proliv Vilkitskogo,*** Y5K8 and the VROD. Some of these vessels were southwest of Iceland. The storm moved slowly northwestward and the rough weather persisted for several days. Another system moved in to take its place on the 24th.

❷ This Low emerged off the U.S. coast near Long Island on the 20th. Forced east northeastward by the large High, it slowly intensified. On the 24th it swung northward to cross the 55th parallel near 20°W, with a central pressure of 997 mb. Its front trailed southwestward, where another wave was coming to life. Between these two systems winds were running 20 to 30 kn with reports of an occasional gale. By the 26th, the system moved north of 65°N, heading for the Barents Sea.

At this time a weak Low was centered in the Labrador Sea and several high pressure centers dotted the North Atlantic. Before the month was out the highs merged into a single 1028–mb system near 30°N, 40°W while a 1000–mb Low moved into Great Britain.

Casualties

On the 10th the 617–ft cruise ship ***Bermuda Star*** ran aground in dense fog off Cape Cod. It was freed some 12 hr later. Divers found a 90–ft tear in the ship's bottom. The rip exposed four tanks holding more than 110,000 gallons of fuel oil. About 1500 gallons leaked before a containment boom was put around the vessel. Eight days later a 465–ft barge carrying 5 million gallons of home heating oil ran aground within about 1 mile from where the ***Bermuda Star*** stranded. Fortunately there was no major spill.

North Pacific Weather April, May, and June 1990

April— The North Pacific climatic chart usually features a broad subtropical high and a broad weakening Aleutian Low during April. This month's outstanding features were a weak high along with a weak Aleutian Low (fig 1). Pressure anomalies of up to –8mb were located near 40°N, 160°W and +8mb were analyzed in the Bering Sea and Gulf of Alaska. This lack of definition in the climatic features shows up well in the storm track chart. There is an abundance of cyclonic activity in the area where the subtropical high is usually located while the Bering Sea is relatively inactive..

The upper air pattern was nearly zonal across the Pacific with a slight turn toward the east northeast near 150°W. This indicates that, in an ideal situation, a Tokyo storm would end up over Portland, OR.

On This Date

April 28, 1963— Typhoon Olive developed a 922–mb center south of Guam. The maximum winds were estimated at 125kn. Peak gusts reached 87kn on Nimitz Hill on Guam, where a 976.5–mb pressure was recorded.

Ocean Weather

❶ The last storm of March was still on the charts as the month opened. Instead of fading away, however, it intensified to 964 mb in the Bering Sea and moved right along the Aleutian Chain and up the Alaska Peninsula during the first few days. This created a few problems. At 0600, the ***Century Leader No. 5*** measured a 984–mb pressure near 53°N, 175°E; her winds were from the north at 48kn. The ***Alain L D*** (52°N, 146°W) also hit 50– kn northwesterlies. Winds of 45 to 55 kn were common through the 2d. The system then weakened as it moved ashore.

For several days a series of weak highs and lows was strung out across the Pacific. On the 6th a 978–mb Low centered in the Sea of Okhotsk trailed a cold front between two large Highs to the south while a large but weak low pressure area covered the eastern North Pacific. Things hadn't changed much by the 8th, although another Low in the Sea of Japan replaced the Sea of Okhotsk storm. This storm was intense enough to generate winds of 40 to 50 kn over the Sea of Japan and western North Pacific. At 1200 on the 8th the OUUU2 ran into a 50–kn southerly near 41°N, 148°E. This continued into the 9th when the storm faded. The Low in the eastern North Pacific meandered toward the Gulf of Alaska but never made it. It developed a couple of centers but by the 14th they fizzled.

On the 15th a number of low pressure centers was strung out across

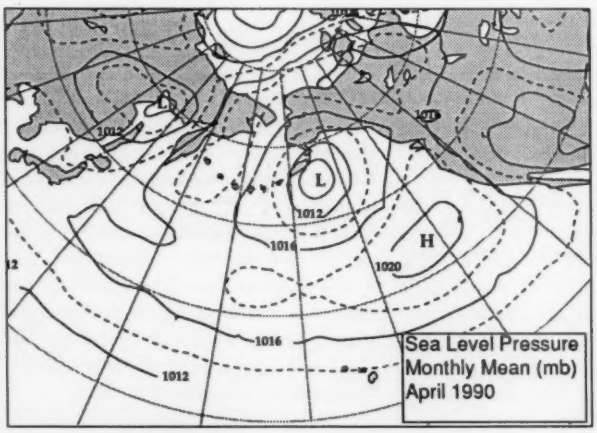

Figure 1.— The Aleutian Low is still very much in the picture during April. Its position resulted in negative anomalies south of 50°S. Also the Gulf of Alaska and Bering Sea had postive anomalies. Chart analysis provided by Vernon Kousky and John Kopman of the Climate Analysis Center.

the Pacific; the largest was a 976–mb Low near 40°N, 175°E. It generated gale force winds south through west of its center. The ***Skaugran*** and ***Prince of Tokyo 2*** ran into 40– to 45–kn winds in seas up to 13 ft. However, this system weakened rapidly as it moved eastward. Two large Highs controlled the weather south of 35°N between 140°E and 130°W, while several weak lows scooted across the northern ocean over the next week or so. On the 17th, a Low in the Gulf of Alaska flared briefly, as pressure dipped to 984 mb the following day (fig 2). It quickly fizzled on the 19th as another center moved into the area from the southwest. This one hit 984 mb on the 20th but weakened rapidly as it approached the Kenai Peninsula. This was followed by another center which moved across the Alaska Peninsula on the 22d and meandered around the Gulf until the 26th. However none of these systems was anything to write home about. In the meantime, a large High established itself in the mid Pacific in a north–south orientation so that it blocked the normal storm path all the way to the Bering St. On its west side a tight pressure gradient was established by the 23d and 24th as a Low was forced northward through the Sea of Okhotsk. The intensity of this gradient was most apparent on the 24th at 0000 and 0600.

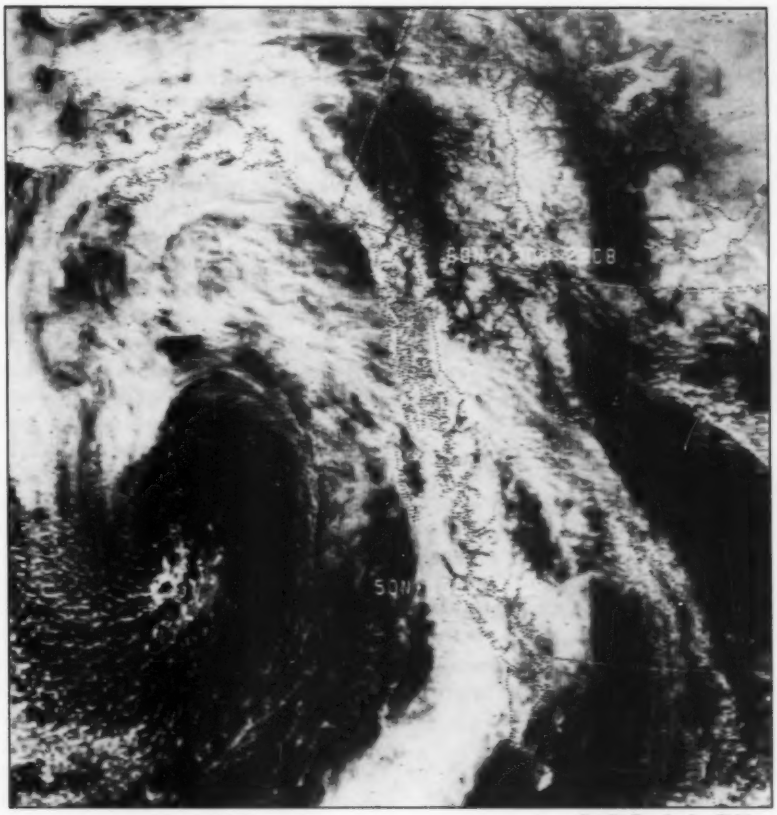

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Figure 2.— This graphic visual satellite photograph was taken on the 18th of April at about 2200 UTC. The storm system dominates weather from the Gulf of Alaska to west of Southern California.

❷ The system developed as a secondary center off Hokkaido on the 23d. At this time its pressure was estimated at 988 mb. Malokurilskoye in the southern Kurils reported a 40 kn southerly at 1200. By 1800 the ***Nikolay Zaytsev*** and EJPP, east of the center, encountered 47–kn winds from the southeast. A dozen vessels in the Sea of Okhotsk and northwestern Pacific reported in at 0000 on the 24th, indicating winds of 40 to 50 kn were being generated by this system and the High to the east. The fetch established brought seas up to 26 ft in some areas. At this time the most intense region was between 35°N and 50°N from 150°E) At 0600 the ***Mekhanik Gordiyenko*** (51°N, 156°E) reported a 58–kn south southeast wind in 13–ft seas. Rough weather extended to 60°N by early on the 25th and the gradient remained tight south to 35°N thanks to a wave along the front of Storm No. 2. Slowly, the High weakened and the storm moved into Siberia, so conditions eased on the 26th. At this time three high pressure systems controlled most of the Pacific.

Before the month came to an end, a Low near 45°N, 160°W flared up briefly on the 29th as its pressure fell to 984 mb. Several vessels reported 30–kn winds at 1200 and this carried into the 30th as it tracked toward the northwest. Far to the south, near 10°N, 150°E Tropical Depression No. 2 became Tropical Storm Lewis on the 29th. However, as the month ended Lewis had weakened to a tropical depression east of the Marianas Islands.

Casualties

The Hong Kong Royal Observatory reports that three people were missing after a freighter and container vessel collided in foggy weather, about 80 mi east of Waglan Is, on the morning of the 20th. Over Bangladesh, on the 24th, heavy winds, rains and hail resulted in 24 deaths.

May— The Pacific subtropical high arrived on schedule and its northeast portion extended well into the Gulf of Alaska (fig 3). However the Aleutian Low was not quite willing to give up the ghost. Centered in the Bering Sea its 1004–mb pressure minimum produced negative anomalies of down to 6 mb. This was reflected at the 500–mb level as well. Steering currents were oriented toward the east northeast, so that, ideally, a storm over Tokyo would end up over San Francisco, thanks to a little east southeastward dip near 140°W. Around the Aleutians this upper pattern was more sharply cyclonic.

On This Date

May 26, 1900 – A typhoon clobbered Guam. Buildings were demolished, trees were uprooted and there was extensive damage to all crops. In Apra Harbor the USS Bratus was torn from her moorings and blown upon the reef.

Ocean Weather

The month began with Tropical Depression Lewis slowly fading away, about 400 mi east of Guam, early on the 3d. A large double–centered High dominated a trough of low pressure over the Gulf of Alaska and to the south a mid Pacific Low was trying to organize. This Low managed to split the high pressure system.

❶ The mid Pacific Low actually formed on the 1st southeast of Hokkaido. It was forced southeastward, looking for a break in the large high pressure system. It found that break the following day and moved through the hole like a running back seeing daylight. By the 3d, it was across the 45th parallel and intensifying. At 1200 its pressure was down to 980 mb. The ***Star Ranger*** noticed this move and reported an east northeast 40–kn wind near 43°N, 171°E. This was verified by the ***Blue Hawk*** (37°N, 177°E) with a 41–kn southerly. The Low remained potent through the 4th as it approached the Aleutians. However, once into the Bering Sea it began to fill.

On the 6th several low pressure centers were strung out along the Aleutians and the two Highs closed ranks to the south. Most of the action was taking place along a cold front, which extended from a Low over the Kamchatka Peninsula. Winds were mostly 20 to 30 kn, but the ***Rainbow Ace*** ran into a local 58–kn east southeasterly near 38°N, 146°E. Conditions slackened the following day as the High moved eastward relieving the pressure (joke). The Low merged with several other centers and made its way across the Bering Sea, as a relatively weak storm. By the 9th, a 1033–mb High was dominating the eastern North Pacific from the Gulf of Alaska to Hawaii. A 986–mb Low moved east northeastward from northern Honshu.

❷ This system from Honshu developed rapidly. Control pressure dropped from 1003 mb at 1200 on the 8th to 986 mb 24 hr later. An excellent report came in from the ***Oriental Fern,*** which encountered a 51–kn north northwest wind in 13 ft seas near 41°N, 154°E. At 0000 on the 10th, the ***Prince of Tokyo 2*** encountered 42–kn northerlies near 45°N, 164°E. The 978–mb center approached the dateline near 52°N at 0000 on the 11th. Nearby, the ***Cedar Forest*** hit 48–kn westerlies in 13–ft seas. At this point the storm began to slowly deteriorate. It did hold on for several more days but was less of a problem for shipping.

On the 13th, the eastern North Pacific High continued to hold its own, while two other centers held sway south of 35°N. Two Lows were apparent— one in the Bering Sea and one just south of the Kamchatka Peninsula. Neither seemed to be generating gales. The Kamchatka Low eventually took control, as it headed eastward the following day. Also, another storm system moved off Tokyo and they were linked by a frontal boundary. They moved in tandem over the next few days on an east northeastward heading. By the 17th the Tokyo Low took control as the Kamchatka Low was held in check by that persistent eastern Pacific High. At 0000, the Tokyo Low was sporting a 980–mb pressure and a few vessels were starting to take notice, while the Alaska Peninsula was being raked by gales. This storm did manage to displace the High but the effort caused it to weaken On the 19th, a large 1035–mb High was centered near 40°N, 165°W and a trough of low pressure extended from the Gulf of Alaska southeastward. This

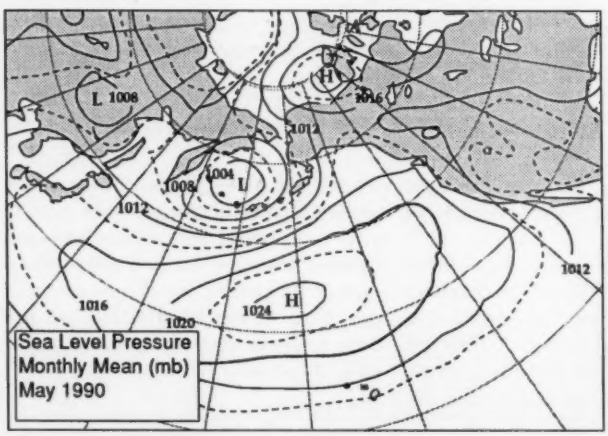


Figure 3.— A classic spring skirmish in the battle for control of the North Pacific ensued in May between the retreating Aleutian Low and the advancing subtropical high. This analysis was provided by Vernon Kousky and John Kopman of the Climate Analysis Center.

combination created strong pressure gradients, which extended from the Alaska Peninsula southeastward several thousand miles. This was an ideal orientation— a long fetch— for building large seas. While some reports of 13– to 15–ft seas were received, conditions didn't last long enough for this to occur. The trough organized into a 990–mb Low with a definite circulation, which caused the High to retreat somewhat. Several moderate low pressure systems skirted the Aleutians during the next several days, and, on the 24th, a relatively potent system came to life in the Sea of Okhotsk.

Typhoon Marian originated as a disturbance, on the 13th, in the Caroline Islands. Moving northwestward it reached tropical storm strength on the 16th, some 60 mi east northeast of Nansha. The ***Fossarina***, about 40 mi from the eye on the 17th, reported winds exceeding 50 kn. Marian attained typhoon intensity that evening as it passed 16 mi east of Xisha. It turned northeastward and ran into drier air, which caused the typhoon to weaken. Marian was a tropical storm by the night of the 18th and made landfall the following morning near Tainan, Taiwan. It degenerated into a tropical depression and despite moving out into open waters, did not reintensify.

This storm was analyzed as a 990–mb Low along the Kuril Is at 1200 on the 24th. For the first few days it looked like any of the other small Lows that were unable to penetrate the wedge of high pressure, which dominated the Pacific. Finally, on the 27th, as it moved south of the Alaska Peninsula, central pressure dropped to 980 mb. Along with a weaker Low to the east, and a moderate Low to the west, it began to cause some problems for shipping over the northern routes. Reports of 40– to 50–kn winds and seas up to 20 ft began to come in. At 0600 on the 29th, the ***Miller Freeman*** (57°N, 156°W) encountered a 70–kn northerly, which may have been caused by a local effect. On the 29th, conditions began to slacken, but another system was moving in from the southwest. As the month came to a close, a 976–mb Low along the eastern Aleutian Is generated gales south of its center. However, by 1200 on the 31st it had filled to 985 mb, although winds of 40 kn were still being reported by the ***Tinro*** and the KDBO.

Casualties

A report received from the Hong Kong Royal Observatory, indicated two people were swept away by waves in Marian, while fishing on Taiwan. Taiwan also suffered crop damage.

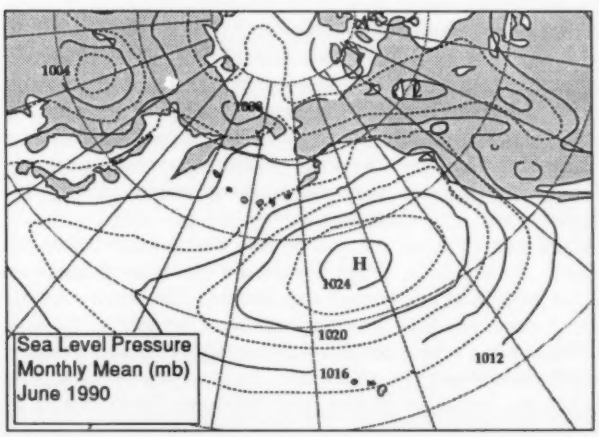


Figure 4.— The subtropical high looks like a textbook drawing for summertime. This June it was even more extensive than normal and forced the remnants of the Aleutian Low into Siberia. The analysis that made this chart possible was provided by Vernon Kousky and John Kopman.

June— The subtropical high stood out on the North Pacific climate chart in June, as it should (fig 4). This year it was even more extensive than normal resulting in positive anomalies over the Aleutians and into the Gulf of Alaska. It forced the normally weak Aleutian Low into Siberia. All this indicates a less active month for storms. The upper air pattern indicated a nearly zonal flow north of about 40 N, which would tend to move a Tokyo storm to San Francisco.

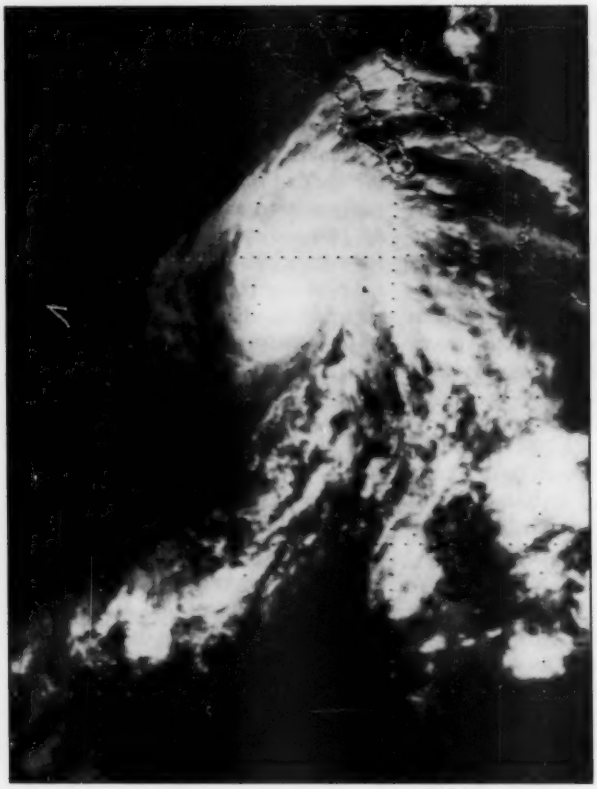
On This Date

June 28, 1978— Ex–Hurricane Carlotta passed over the Alenuihaha Channel between the Big Island of Hawaii and Maui. It was one of Hawaii's major weather producers and rainfall amounts as high as 6 in. were reported.

Ocean Weather

The month opened with a good–sized Low, left over from May, covering the northeastern North Pacific. The storm generated 20–to 30–kn winds south and west of its center, which was replaced by another center on the 2d. A series of small centers roamed the northern shipping lanes for several days, but none dominated. The most potent activity at this time was in the eastern North Pacific where Hurricane Boris was developing (fig 5). Boris crossed the 20th parallel, on the 6th, heading north northwestward as a hurricane. By the 7th, it fell to tropical depression strength and turned toward the Baja Peninsula. The depression moved into California the following day, and remained an identifiable extratropical system, until the 11th, as it moved across the northern U.S.

On the 9th a 986–mb Low and its associated frontal system had organized near 45N°, 175°W. It had started on the 5th, east of Tokyo, but



Satellite Data Services Division

Figure 5. Hurricane Boris lingers off the Mexican coast at about 2000 UTC on the 5th. It eventually crossed the Baja Peninsula and moved into the southwestern U.S. as a tropical depression. The remnants of Boris remained as a low pressure area on the weather charts until the 11th.

remained relatively quiet during the first few days of its existence. In general, on the 9th, winds blew at 20 to 30 kn in the storm's southern semicircle out to about 600 mi. The Low continued toward the northeast and slowly filled.

By the 12th, two large Highs dominated most of the North Pacific with a Low over Kamachatka, and another between the Highs, just east of the dateline. The mid ocean Low scooted northeastward into the Gulf of Alaska by the 14th, while the Kamchatka system meandered eastward. Neither created much of a stir. The eastern High continued to build and forced its way over the Gulf of Alaska by the 16th. Butting up against it was a 990–mb Low, which had formed east of Hokkaido on the 13th. The High forced the storm into the eastern Bering Sea, where it fizzled over Bristol Bay on the 18th.

In the western North Pacific Nathan originated as a tropical depression, which had formed over the South China Sea on the 15th. Moving rapidly westward, at first, it slowed as it neared Xisha. After completing a loop on the 16th, Nathan moved toward the north northwest and intensified to severe tropical storm strength the following day. It crossed the Leizhou Peninsula on the 18th and dissipated in Guangxi during the night. See the casualty section for more details.

Ofelia developed some 800 mi east southeast of Manila, on the 18th, and moved toward the northwest. It intensified to a tropical storm the following day. By the 20th, it was a severe tropical storm some 480 mi east southeast of Manila. Ofelia reached typhoon intensity on the 21st about 260 mi east of Manila. It began to recurve the following day and moved over the Bashi Channel, making landfall about 80 mi south of Taipei, Taiwan on the 23d. After crossing the Taiwan St, Ofelia again made landfall over mainland China on the 24th. It weakened to tropical storm strength during the day and entered the Yellow sea early on the 25th. It finally became a depression, then a weak area of low pressure south of Seoul, Korea by late on the 25th.

In the meantime Percy had formed on the 21st, some 200 mi south southeast of Guam. It reached typhoon intensity, on the 24th, and crossed northern Luzon 3 days later. Percy made landfall over southern China on the 29th. See the casualty section for more details on Ofelia and Percy.

In the eastern North Pacific in addition to Boris there were three other named tropical cyclones in July–Christina, Douglas and Elida.

On the 19th of June, meanwhile, a pair of low pressure systems was tracking across the North Pacific between 40° and 50°N. While neither was particularly intense, a few strong winds are worth mentioning. At 1200 the ***Bay Bridge*** (38°N, 144°E) reported a 54–kn southerly, possibly just ahead of a cold front. Also the ***President Polk*** (47°N, 167°W) encountered 40–kn westerly just south of this easternmost low. However, that was pretty much it, although the eastern storm maintained its identity as it moved across the northeastern North Pacific, running aground over southeastern Alaska on the 22d. It did manage to generate some 20–to 30–kn winds during this trek.

By the 22d a huge 1038–mb High dominated nearly the entire eastern North Pacific. There were several small low pressure centers to the west in addition to tropical Storm Douglas, off Mexico, Tropical Storm Percy, near Guam ,and Typhoon Ofelia closing in

on Luzon. The High forced Douglas inland that same day and it eventually ended up as a low pressure center over Lake Erie 5 days later.

The High continued to persist through the end of the month. During that period, while Percy continued and Elida developed, an extratropical system flared up briefly over western waters. It came to life on the 27th, well east of Honshu, as a frontal wave. It quickly developed a circulation, and by the 28th, at 1200, sported a 986–mb center near 37°N, 165°E. Winds near the center were ranging from 15 to 30 kn. The storm was forced northeastward by the 1030–mb High. It started to weaken, although the ***Jinyu Maru***, to the southwest of the center, reported a 52–kn northerly at 1200 on the 29th. There were no other indications of storm or gale force winds as the month closed with relatively placid weather over most of the ocean.

Casualties

While Nathan was roaming the northern part of the South China Sea, disturbed weather along the periphery of its circulation brought winds and squalls to the south China coast. The cargo ship ***Tien Fu*** sank on the 16th near the Ninepin Is. The captain was listed as missing and the three crewmen drowned in rough seas. In Hong Kong two people were swept away by surging waves while swimming and rowing. In Macau, two men were reported missing after being swept overboard from a dredger on the 17th. In eastern Guangdong torrential rain, associated with Nathan, was responsible for 10 deaths.

Ofelia's torrential rains ravaged Luzon and Taiwan. In northern Luzon at least 40 people were killed while in Taiwan there were 12 deaths with another 25 missing. Floods and landslides were the major cause of death and damage. Another 30 people died when Ofelia hit mainland China. In the Taiwanese harbor of Hualian the 10,900–ton freighter ***Cahaya*** broke into three sections, while the 7,000–ton freighter ***Juliana*** ran aground.

Port Reports

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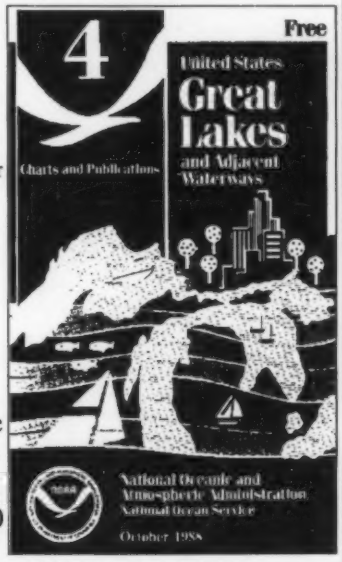
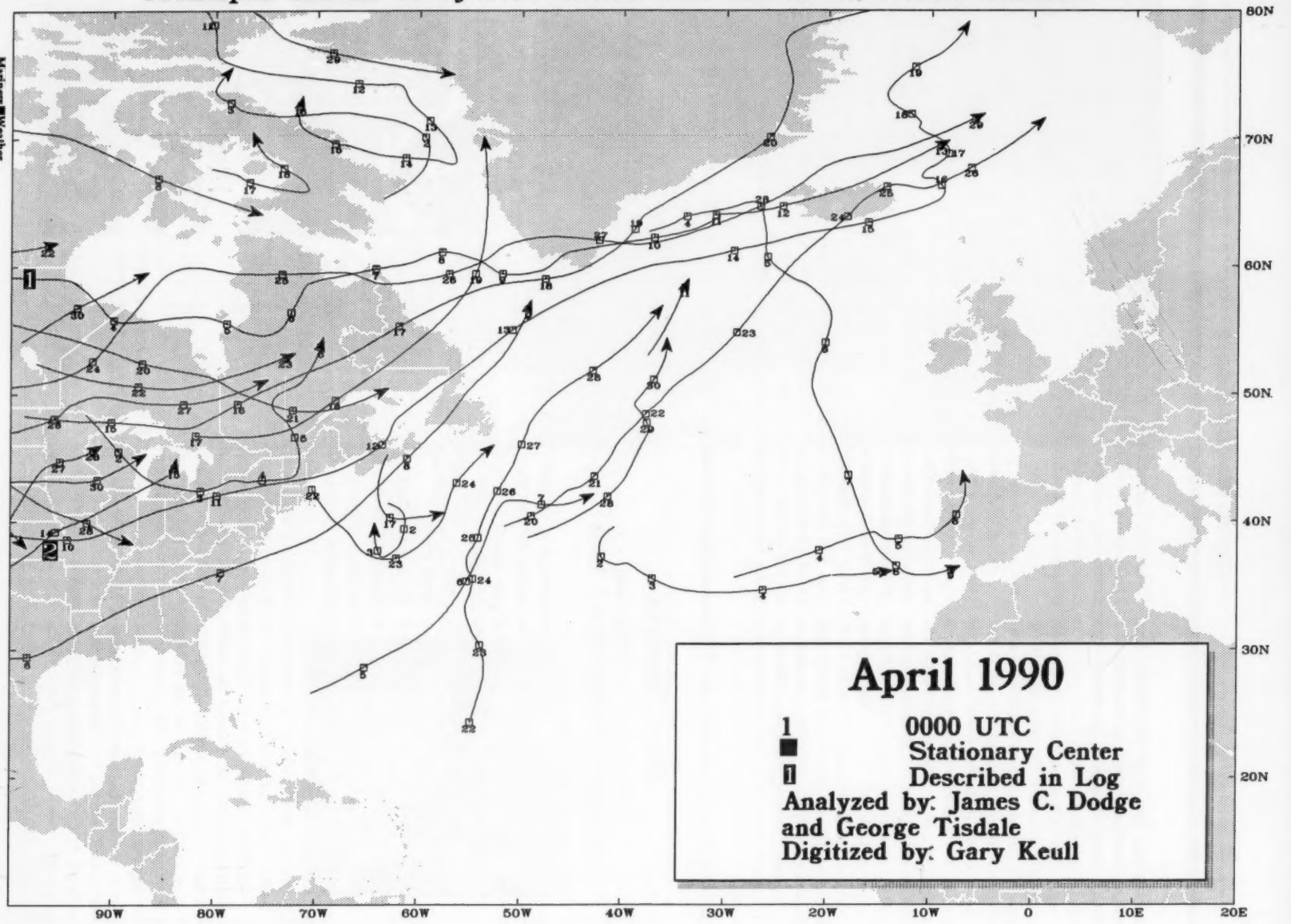
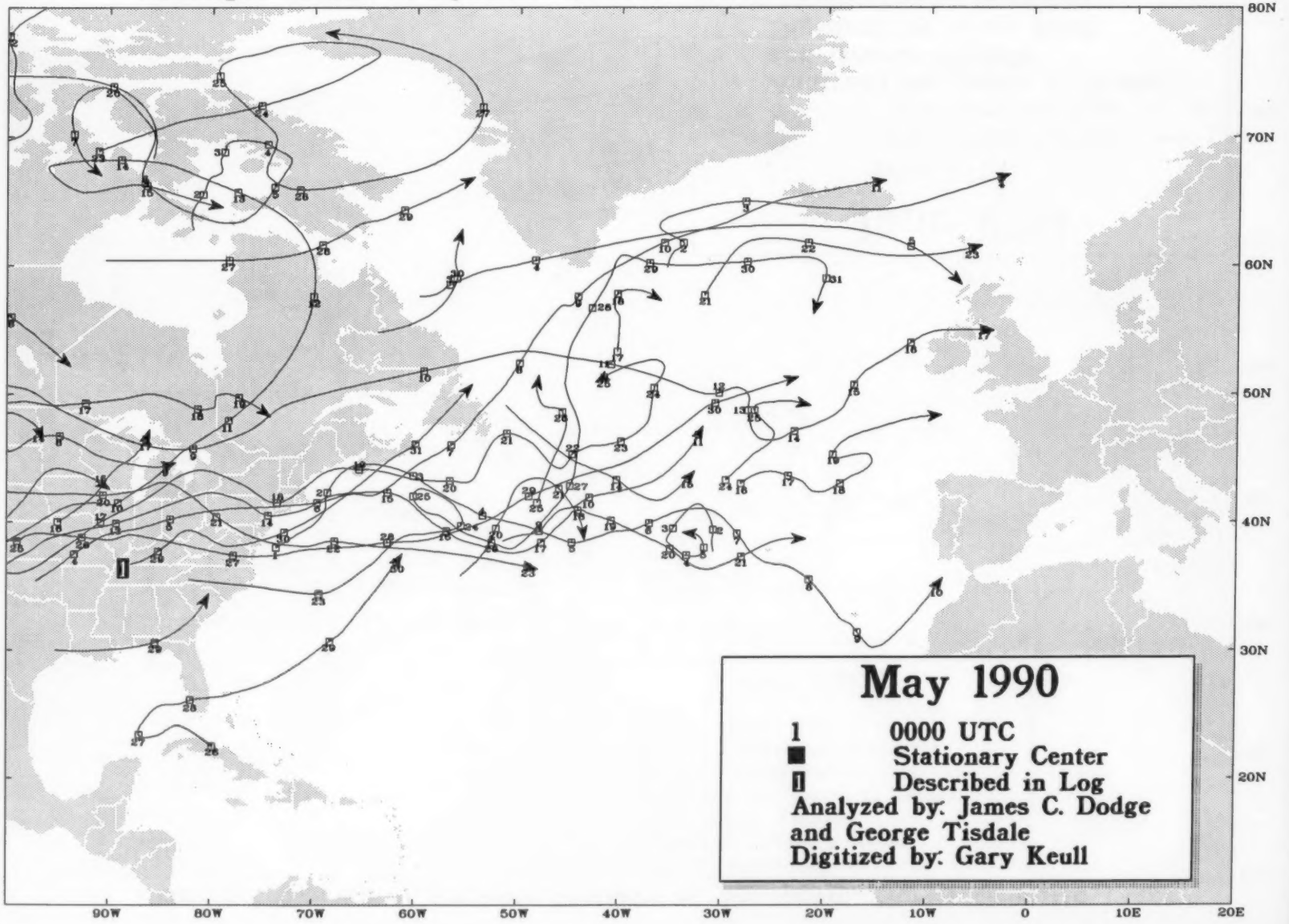


Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



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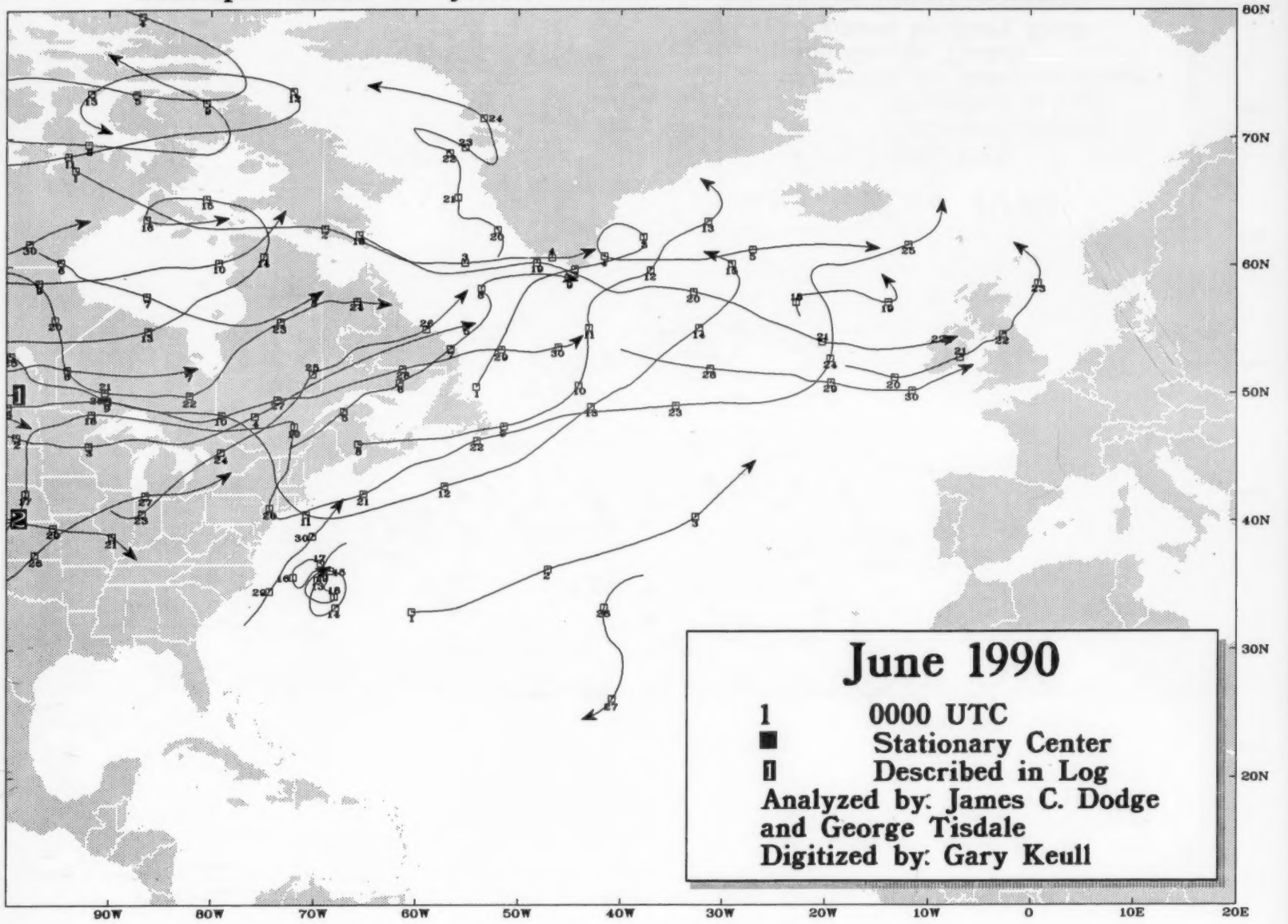
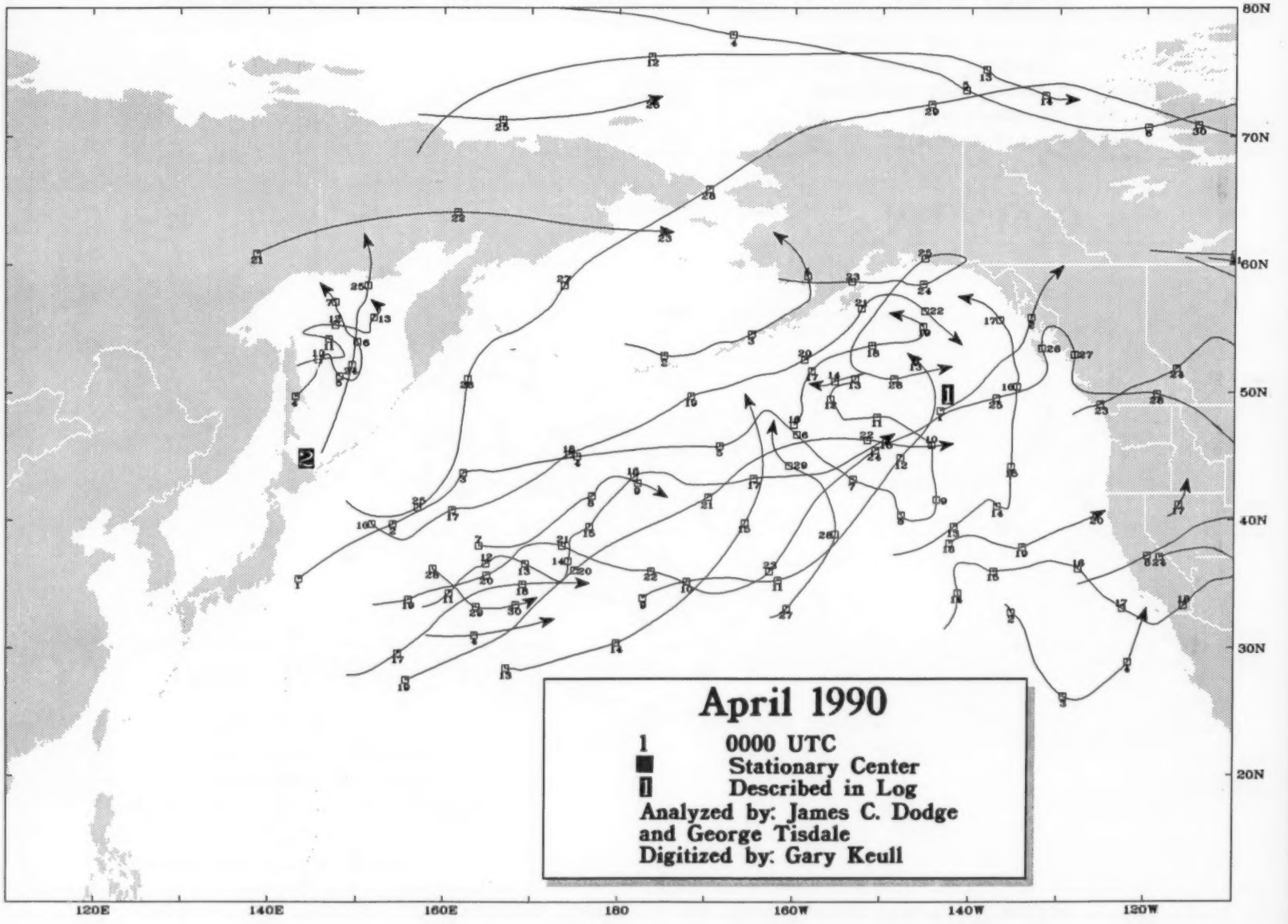
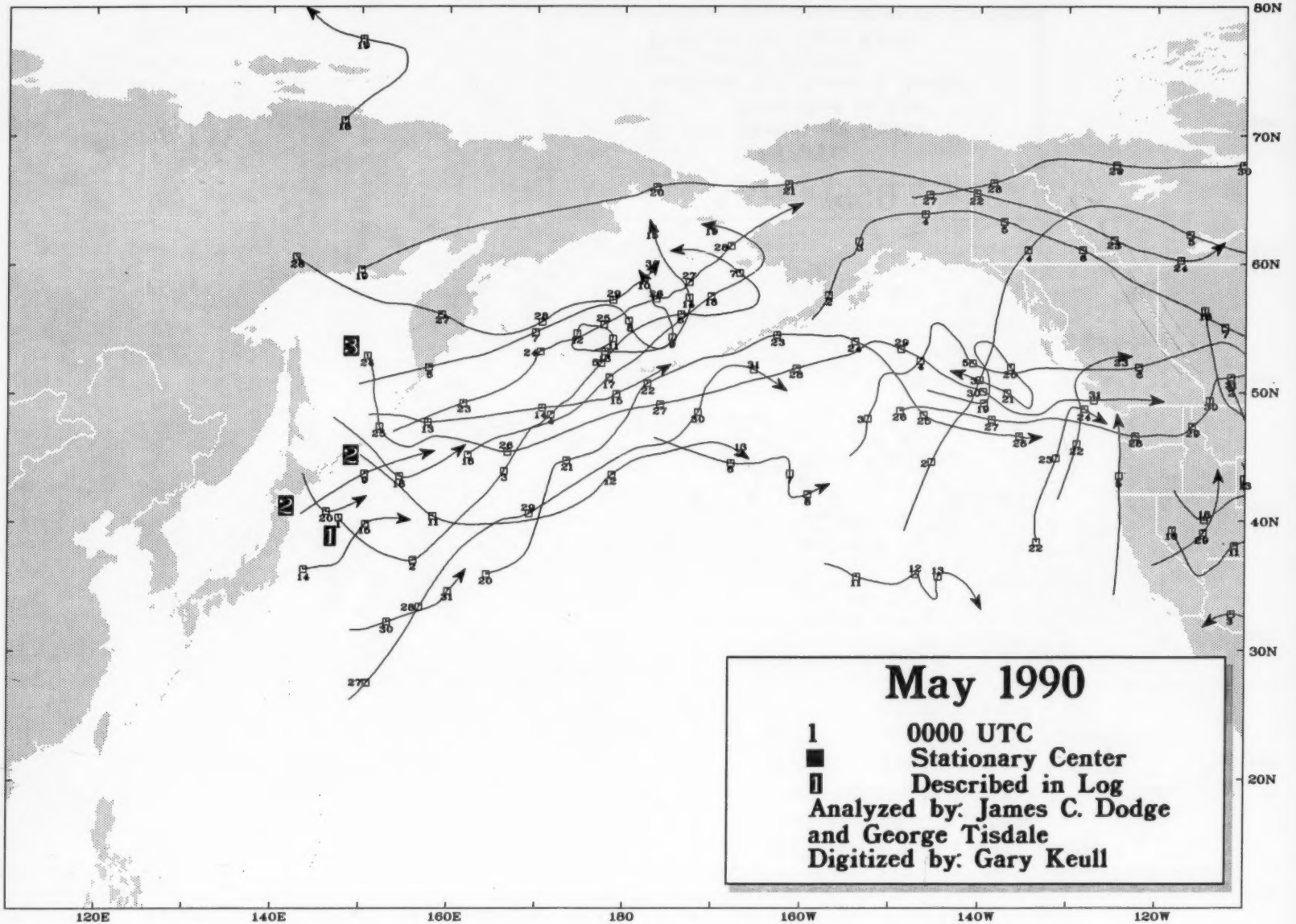


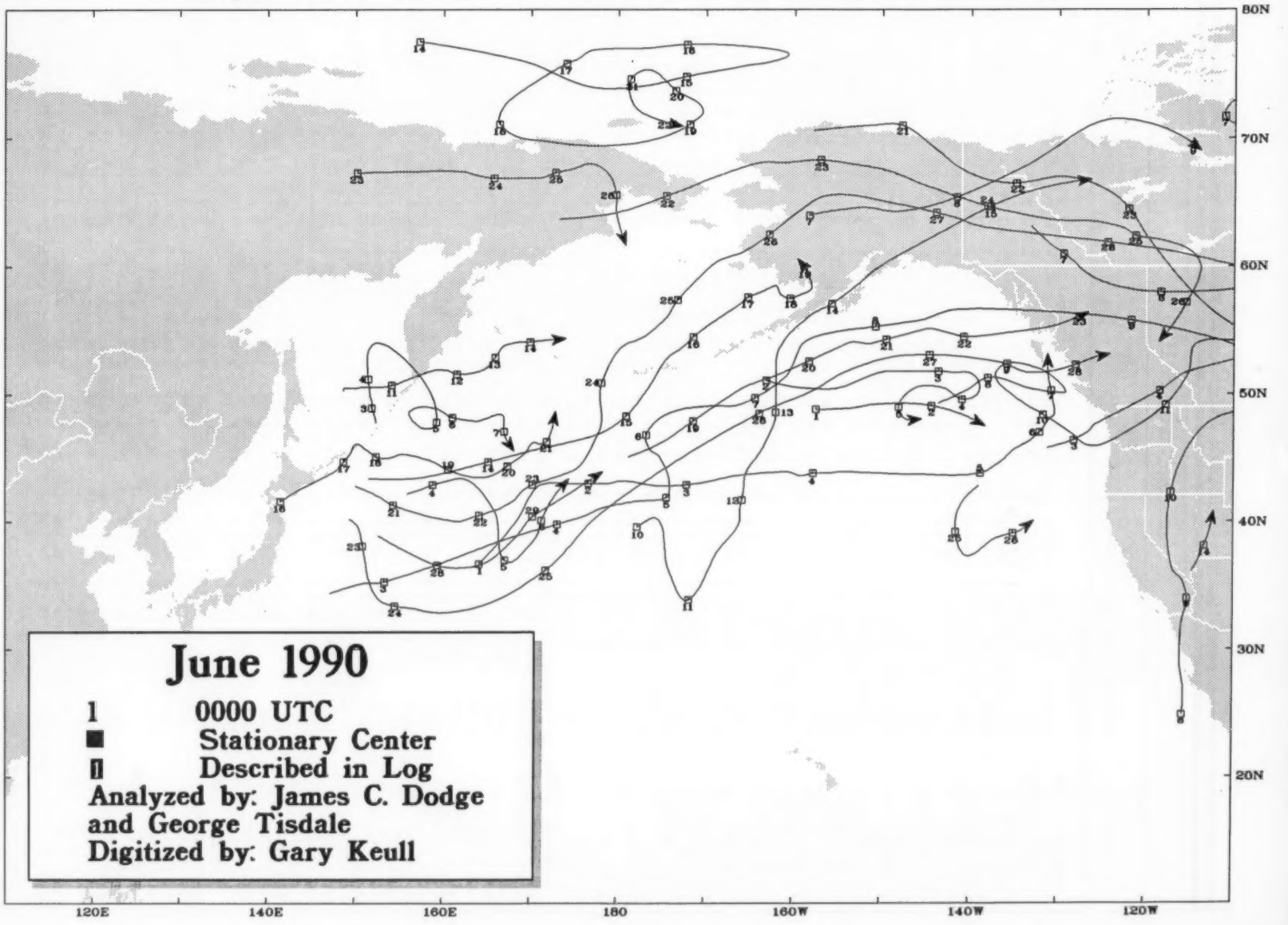
Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



Principal Tracks of Cyclone Centers at Sea Level, North Pacific



April, May, and June 1990

VESSEL	SHIP CALL	DATE	POSITION LAT. DEG.	POSITION LONG. DEG.	TIME UTC	WIND DIR. 10 DEG.	WIND SPEED KTS.	VSBY	PRES WX. CODE	PRESSURE MBS.	TEMP DEG C. AIR	TEMP DEG C. SEA	SEA WAVES PD. SEC	SEA WAVES HGT. FT.	SWELL WAVES DIR	SWELL WAVES PD. SEC	SWELL WAVES HGT. FT.
PACIFIC APR.																	
OCEAN SEL	3ETR3	1	37.4 N	173.6 W	00	18	M 48	1 NM	64	1011.0	14.0	20.4	18	29.5			
PRESIDENT EISENHOWER	KRJG	1	35.8 N	144.7 E	00	16	M 40	2 NM		1004.5	17.5	21.8	5	10	16	8	19.5
NATIONAL HONOR	DZDI	1	53.6 N	179.4 W	06	14	M 40	< 50 YD		0993.0	1.0	7.0	8	26	14	10	29.5
NATIONAL HONOR	DZDI	1	53.4 N	177.9 E	12	14	M 40			0997.5	2.0	7.0	8	26	14	9	29.5
SEALAND EXPRESS	KGJD	2	53.2 N	172.9 E	00	34	M 45			1002.1	2.0	0.0	4	10	34	6	23
SEALAND PRODUCER	WJBJ	2	36.5 N	140.5 W	00	36	40	10 NM	01	1021.3	12.2	11.1	6	16.5	30	12	19.5
ARCTIC TOKYO	5LJT	2	53.5 N	177.8 W	12	32	M 45	5 NM		0993.0	1.0	3.0	7	23			
ARCTIC TOKYO	5LJT	2	53.5 N	179.9 E	18	32	M 40	5 NM		1006.0	0.5	3.0	7	23			
PRESIDENT JACKSON	WRYC	3	53.9 N	178.0 W	00	32	M 50	5 NM	02	1005.5	1.0	2.0	8	23	33	14	36
THOMPSON PASS	WSRY	3	59.6 N	145.3 W	18	14	52	2 NM	81	1014.5	9.5	4.2	2	10	13	6	26
LNG AQUARIUS	WSKJ	4	30.1 N	126.4 E	06	34	M 42	5 NM		1013.0	11.0	18.9	8	6.5	34	10	23
SPRING VEGA	ELEL7	4	43.4 N	167.0 W	18	15	M 43	1 NM	60	1000.4	9.0	8.0	10	18	15	11	19.5
MC KINNEY MAERSK	OWEQ2	4	45.7 N	164.2 W	18	18	M 58	.5 NM	63	1002.8	8.4	9.7	6	19.5			
MC KINNEY MAERSK	OWEQ2	5	45.7 N	161.2 W	00	18	60	.25 NM	63	1006.0	7.1		6	19.5			
PRESIDENT JACKSON	WRYC	5	45.5 N	152.9 E	06	17	M 48	200 YD	26	0998.0	3.9	0.2	7	24.5	18	9	24.5
PRESIDENT JACKSON	WRYC	5	45.1 N	152.3 E	08	19	M 50	200 YD	53		4.4	0.3	10	24.5	17	14	24.5
MC KINNEY MAERSK	OWEQ2	5	45.3 N	155.3 W	12	18	M 45	1 NM		1013.0	8.1		6	19.5			
MC KINNEY MAERSK	OWEQ2	5	45.1 N	152.1 W	18	14	M 50	2 NM		1015.0	8.6	9.2	6	19.5			
SEALAND MARINER	KGJF	6	46.9 N	161.8 W	05	34	M 49			1003.8	3.3	6.1	8	14.5	34	12	29.5
SOARER CUPID	DZRF	8	36.7 N	146.8 E	12	19	M 49	1 NM		1003.0	15.0	15.0	9	16.5	19	18	29.5
LEDA MAERSK	OULU2	9	43.1 N	157.5 E	00	16	M 44	2 NM	60	1010.0	7.6		8	21			
PRESIDENT TYLER	WEZM	15	41.9 N	168.9 E	12	36	M 42	10 NM	02	0996.5	3.9	4.4	6	13	06	7	21
PRESIDENT TYLER	WEZM	15	41.3 N	171.3 E	18	33	M 44	5 NM	02	0996.5	6.1	8.9	6	13	33	10	21
PRESIDENT TYLER	WEZM	16	41.4 N	173.3 E	00	33	M 45	5 NM	02	0996.2	6.1	8.3	7	14.5	33	8	21
SEALAND PACIFIC	WSRL	23	34.3 N	149.7 E	06	22	M 40	1 NM	63	1005.5	17.8	15.6	7	19.5	13	11	19.5
GREEN BAY	KGTH	23	37.4 N	153.0 E	18	15	M 47	1 NM	51	1000.3	15.0		4	14.5	15	12	26
USNS CAPELLA	NBXO	24	42.3 N	158.7 E	06	19	40	.5 NM		1017.3	11.1	4.4	9	32.5			
MITLA	XCMI	28	42.5 N	155.7 W	12	22	41	.25 NM	41	0998.0	6.0	6.0	10	19.5	20	12	21
VAN TRADER	ELLE3	28	49.9 N	161.8 W	18	03	M 47	5 NM	02	1012.5	4.5	4.0	8	14.5	04	10	19.5
VAN TRADER	ELLE3	29	49.6 N	161.2 W	00	07	M 46	200 YD	07	0998.5	5.0	4.0	14	19.5	05	14	19.5
VAN TRADER	ELLE3	29	49.1 N	160.8 W	06	12	M 42	.25 NM	07	0994.0	5.0	4.0	12	19.5	11	12	19.5
ATLANTIC APR.																	
HUAL ANGELITA	LAFB4	1	43.9 N	31.3 W	00	08	M 42	10 NM		1012.5	13.0		6	19.5			
SEALAND PERFORMANCE	KRPD	1	40.3 N	47.9 W	06	36	M 40	5 NM	02	1010.0	8.3		3	6.5	36	9	19.5
HUAL ANGELITA	LAFB4	1	45.3 N	24.7 W	18	08	M 48	10 NM		1017.5	12.0		6	19.5			
HUAL ANGELITA	LAFB4	2	46.2 N	20.3 W	06	08	M 45	10 NM		1017.5	10.0		6	19.5			
HUAL ANGELITA	LAFB4	2	46.7 N	17.9 W	12	08	M 40	5 NM		1019.5	9.0		6	19.5			
HUAL ANGELITA	LAFB4	4	47.2 N	15.6 W	18	07	M 45	10 NM		1019.0	9.0		7	19.5			
GOLDEN ENDEAVOR	WDBU	6	52.9 N	26.4 W	00	31	45	5 NM	87	1010.0	7.2	7.8	6	8	32	10	21
KITTANING	KGPK	6	46.2 N	28.6 W	12	35	M 45	5 NM	15	1016.6	10.0	13.3	8	10	34	14	26
LOUIS MAERSK	OXMA2	6	49.7 N	23.3 W	12	34	M 41	5 NM		1000.0	10.0	12.0	8	19.5	36	10	23
GOLDEN ENDEAVOR	WDBU	6	51.9 N	27.8 W	12	32	45	5 NM		1016.0	12.2	7.8	9	5	33	16	24.5
HUAL ANGELITA	LAFB4	12	46.8 N	24.6 W	12	24	M 45	10 NM		1020.0	12.0	10.0	7	23			
HUAL ANGELITA	LAFB4	13	45.7 N	26.4 W	00	27	M 48	10 NM		1026.0	13.0	12.0	6	23			
HUAL ANGELITA	LAFB4	13	44.1 N	31.3 W	18	26	M 50	10 NM		1035.0	15.0	10.0	6	19.5			
HUAL ANGELITA	LAFB4	14	43.5 N	33.2 W	00	26	M 50	5 NM		1036.0	14.0	10.0	6	19.5			
HUAL ANGELITA	LAFB4	14	42.8 N	37.1 W	12	26	M 44	5 NM		1033.0	16.0	10.0	6	19.5			
PACIFIC MAY																	
GREEN LAKE	KGTI	1	35.0 N	144.7 E	12	34	M 45	10 NM		1012.5	13.0		5	10	36	10	26
SOARER CUPID	DZRF	11	51.1 N	167.6 E	12	33	M 44	1 NM		0998.0	3.5	3.0	15	19.5	30	15	24.5
SOARER CUPID	DZRF	14	41.6 N	146.7 E	18	08	M 40	1 NM		0998.3	7.0	5.0	9	14.5	07	11	19.5
MITLA	XCMI	30	36.8 N	164.0 E	18	09	M 46	2 NM	63	1010.0	16.0	15.0	10	23	09	12	23
ATLANTIC MAY																	
EXPORT FREEDOM	WCJS	6	36.1 N	35.9 W	06	29	40	5 NM	81	1000.0	15.6	17.8	4	11.5	29	8	23
STAR EAGLE	LAWO2	18	40.3 N	47.1 W	12	30	48	2 NM	07	0997.0	13.5		6	26	32	10	28
STAR EAGLE	LAWO2	18	39.8 N	45.3 W	18	34	45	5 NM	07	0997.0	17.5		8	23	34	12	28
PERSEVERANCE	S6HT	31	42.5 N	52.8 W	12	26	M 50			1005.0	15.0	0.0	14	24.5	25	14	26
PACIFIC JUNE																	
SKAUBORD	LADC2	13	51.6 N	158.1 W	12	19	M 40	2 NM	80	1007.0	6.5	8.0	7	19.5	20	8	21
SKAUBORD	LADC2	14	51.7 N	153.0 W	00	22	M 44	5 NM	41	1014.0	10.0	8.0	8	19.5	22	9	23
ASPEN	KACN	21	47.9 N	151.2 W	00	25	40	5 NM		1013.1	12.5	8.3	4	8	26	7	19.5
ATLANTIC JUNE																	
SONORA	XCSG	20	48.6 N	06.2 W	00	26	M 46	5 NM	18	0997.5	14.0		10	19.5	26	12	23
SONORA	XCSG	22	48.3 N	06.7 W	06	26	M 43	5 NM	50	1003.0	14.0		9	19.5	26	10	21

April, May, and June 1990

Ship Name	radio	mail
1ST LT ALEX BONNYMAN	65	128
2ND LT. JOHN P. BOBO	39	
A. V. KASTNER	135	
ACE ACCORD	35	
ACT 11	34	
ACT 111	206	
ACT 12	13	
ACT 5	141	
ACT 6	73	
ACT 7	199	
ACT I	112	
ACT IV	2	
ADABELLE LYKES	128	155
ADDIRIYAH	76	40
ADMIRALTY BAY	57	97
ADVANTAGE		34
AEL AMERICA	3	
AEL EUROPA	7	
AFRICAN FERN	46	67
AGNES	88	110
AINO	47	120
ALASKA RAINBOW	33	
ALBERT MAERSK	9	23
ALDEN W. CLAUSEN	39	149
ALEMANIA EXPRESS	35	
ALLIGATOR FORTUNE	12	17
ALLIGATOR GLORY	25	8
ALLIGATOR HOPE	45	101
ALLIGATOR LIBERTY	75	
ALLIGATOR PRIDE	52	61
ALMERIA LYKES	46	100
ALPHA HELIX	186	115
ALTAMONTE	27	33
AMADEUS	1	
AMBASSADOR BRIDGE	85	21
AMERICA EXPRESS	51	
AMERICA MARU	186	
AMERICAN CONDOR	20	20
AMERICAN CORMORANT	2	
AMERICAN EAGLE	94	108
AMERICAN FALCON	29	46
AMERICAN REPUBLIC	84	150
AMERICAN TRADER	23	48
AMERIGO VESPUCCI	33	4
ANASTASTS	12	6
ANDERS MAERSK	63	70
ANTHONY RAINBOW	19	120
AQUA CITY	87	118
AQUA GARDEN	36	75
ARCO ALASKA	21	39
ARCO ANCHORAGE	28	28
ARCO CALIFORNIA	28	15
ARCO FAIRBANKS	19	21
ARCO INDEPENDENCE	3	5
ARCO JUNEAU	33	40
ARCO PRUDHOE BAY	38	31
ARCO SAG RIVER	10	20
ARCO SPIRIT	5	6
ARCO TEXAS	19	
ARCTIC DISCOVERER	6	17
ARCTIC OCEAN		11
ARCTIC TOKYO	76	155
ARGONAUT	30	131
ARILD MAERSK	1	
ARMCO	159	202
ARNOLD MAERSK	60	116
AROSIA	32	
ARTHUR M. ANDERSON	130	80
ASHLEY LYKES	19	24
ASPEN	48	92
ASTERIKS	1	
ASTORIA	127	
ASTRO JYOJIN	25	79
ASTRO VENUS	39	101
ATIGUN PASS	52	131
ATLA	9	12
ATLANTIC	18	
ATLANTIC CARTIER	124	
ATLANTIC CONVEYOR	131	
ATLANTIC OCEAN	24	12
ATLANTIS II	53	
ATLAS HIGHWAY	12	
AURORA ACE	72	
AUSTRAL RAINBOW	49	99
AXEL MAERSK	23	
B.T. SAN DIEGO	81	233
BAAB ULLAH	2	
BAJKA	67	70
BALTIMORE TRADER	7	
BAR' ZAN	12	34
BARRYDALE	148	
BAY BRIDGE	142	63
BCR KING	91	
BEBEOURO	38	
BEER SHEVA	9	
BELGIAN SENATOR	45	
BELLFLOWER	26	
BIBI	138	
BISLIG BAY	6	42
BLUE HAWK	72	
BOGASARI DUA	62	85
BOGASARI EMPAT	39	29
BOGASARI LIMA	46	92
BOHOL SAMPAGUITA	22	98
BONN EXPRESS	60	
BOW CHASER	24	
BOW SELENE	10	
BRIGIT MAERSK	52	67
BRILLIANCY	4	80
BRILLIANT ACE	171	
BROOKLYN BRIDGE	75	63
BROOKS RANGE	17	2
BUM DONG	2	
BUNGA KANTAN	34	77
BUNGA KENANGA	19	
BUNGA KESIDANG	8	52
BUNGA MELAWIS	4	
BURNS HARBOR	185	271
CALCITE II	81	95
CALGA	18	
CAPE BYRON	3	
CAPE HENRY	32	
CAPE YORK	20	
CAPRICORN	11	6
CARIBAN	147	117
CARIBE 1	1	37
CARLA A. HILLS	14	160
CARMEL	24	82
CAROL	3	
CAROLINA	23	137
CARTAGENA	17	
CASON J. CALLAWAY	207	237
CATTLEYA ACE		35
CELEBRATION	20	
CENTURY HIGHWAY #2	218	103
CENTURY HIGHWAY NO. 5	186	20
CGM LORRAINE	26	
CGM PROVENCE	26	
CHABLIS	51	92
CHACO	18	
CHALLENGER	52	
CHARLES E. WILSON	98	141
CHARLES M. BEEGHLEY	7	
CHARLES PIGOTT		225
CHARLOTTE LYKES	132	180
CHEMICAL PIONEER	71	79
CHERRY VALLEY	35	81
CHESAPEAKE TRADER	41	31
CHESNUT HILL	12	
CHEVRON BURNABY	22	
CHEVRON CALIFORNIA	61	70
CHEVRON COLORADO	35	53
CHEVRON COPENHAGEN		142
CHEVRON EDINBURGH	26	149
CHEVRON EQUATOR	1	
CHEVRON FELUY		73
CHEVRON LONDON		84
CHEVRON LOUISIANA	64	108
CHEVRON METEOR	22	157
CHEVRON MISSISSIPPI	48	107
CHEVRON NAGASAKI	23	104
CHEVRON OREGON	19	26
CHEVRON PACIFIC	41	116
CHEVRON STAR		71
CHEVRON SUN		200
CHRISTINA	108	124
CITADEL HILL	29	
CLARENCE	57	
CLEMENT	64	
CLEMENTINA	12	
CLEVELAND	10	59
COAST RANGE	20	
COLIMA	49	74
COLUMBIA STAR	72	161
COLUMBUS AMERICA	34	
COLUMBUS AUSTRALIA	80	
COLUMBUS CANADA	227	
COLUMBUS LOUISANA	154	
COLUMBUS NEW ZEALAND	161	
COLUMBUS OHIO	157	245
COLUMBUS OLIVOS	86	36
COLUMBUS ONTARIO	57	68
COLUMBUS OREGON	87	
COLUMBUS QUEENSLAND	30	
COLUMBUS VICTORIA	179	
COLUMBUS VIRGINIA	151	
COLUMBUS WELLINGTON	124	
COLUNBIA STAR	1	
COMPANION EXPRESS	43	
CONCERT EXPRESS	83	
CONTIENTAL WING	36	82
CONTINENTAL HIGHWAY	39	
CONTSHIP AUSTRALIA	19	
CORAH ANN	60	23
CORMORANT ARROW	58	15
CORNUCOPIA	40	79
CORONADO	7	
CORWITH CRAMER	23	
COURTNEY BURTON	95	182
CPL. LOUIS J. HAUGE JR		69
CRISPEN OGLEBAY	53	55
CRISTOFORO COLOMBO	25	58
CSS HUDSON	205	
CYPRESS PASS		15
CYPRESS TRAIL	22	17
D.L.BOWER		161
DEL MONTE PACKER		44
DELAWARE TRADER	31	108
DIANA		11
DILIGENCE TRADER	30	35
DIRECT EAGLE	56	
DOLE ECUADOR	15	165
DONAIRE		63
DUSSELDORF EXPRESS	48	
DYVI OCEANIC	1	
DYVI SKAGERAK	7	108
EASTERN GLORY	26	91
EASTERN VENTURE	32	37
EDEN	25	90
EDGAR B. SPEER	242	262
EDGAR M. QUEENY	1	35
EDWARD L. RYERSON	125	164
EDWIN H. GOTT	206	178
ELIZABETH LYKES	14	31
EMERALD SEA	133	47
ENDEAVOR	17	
ENSOR	95	125
ERLANGEN EXPRESS	2	
ESPERANZA	29	
ESSO PUERTO RICO	26	64
ETERNITY	23	
EVER GALLANT	20	15
EVER GENIUS	6	
EVER GENTRY	1	
EVER GIANT	2	
EVER GIFTED	7	11
EVER GIVEN	9	6
EVER GLAMOUR	3	
EVER GLEAMY	16	28
EVER GLOBE	4	27
EVER GLOWING	8	5
EVER GOING	10	25
EVER GOVERN	18	24
EVER GRACE	3	
EVER GROUP	9	3
EVER GROWTH	9	
EVER GUIDE	29	17
EVER LAUREL	4	11
EVER LEVEL	12	18
EVER LINKING	25	53
EVER LIVING	34	43
EVER LYRIC	13	24
EXPORT FREEDOM	38	119
EXPORT PATRIOT	40	118
EXXON BATON ROUGE	17	31
EXXON BENICIA		2
EXXON LONG BEACH	10	12
EXXON PHILADELPHIA	34	45
FALSTAFF	34	
FALSTRIA	39	34
FARNELLA	85	
FAUST	66	50
FERNCROFT	118	169
FESTIVALE	2	74
FETISH	103	102
FIGARO	48	53
FLORIDA RAINBOW	49	101
FOREST SOVEREIGN	62	178
FORTALEZA	56	228
FRANCES HAMMER	106	42
FRANCIS SINCERE NO. 6	34	
FRED R. WHITE JR	31	66
FREDERICKSBURG	24	33
FROTASIRIUS	22	
FUJI	54	95
GALVESTON BAY	60	166
GATEWAY EAST	29	149
GENEVIEVE LYKES	61	112
GEORGE A. SLOAN	145	121

Ship Name	radio	mail
GEORGE A. STINSON	80	161
GEORGE WASHINGTON BRID	196	
GEORGIA		46
GERMAN SENATOR	38	
GERONIMO	44	25
GLACIER BAY	5	4
GLOBAL FAME	58	48
GLORIOUS SPICA	16	
GOLDEN ENDEAVOR	52	186
GOLDEN GATE	2	
GOLDEN GATE BRIDGE	217	60
GOLDEN MONARCH	7	27
GOLDEN TRADER	7	57
GRAIGLAS	152	
GREAT LAND	143	254
GREEN ANGELES	11	14
GREEN BAY	113	220
GREEN ENGELES	12	8
GREEN HARBOUR	25	18
GREEN ISLAND	21	
GREEN KOBE	9	36
GREEN LAKE	99	126
GREEN MASTER	59	72
GREEN MAYA	48	43
GREEN RAINIER	27	94
GREEN RIDGE	113	123
GREEN SASEBO	55	134
GREEN STAR	38	44
GREEN VALLEY	12	
GREEN WAVE	72	139
GUANAJUATO	95	
GUAYAMA	8	36
GULF SENTRY	18	94
GULF SPIRIT	14	
GYPSUM BARON	163	
GYPSUM KING	144	
HAKONE MARU	134	
HANEI SKY	39	45
HANEI SUN	63	19
HANJIN BUSAN	38	11
HANJIN CHEJU	37	
HANJIN CHUNGMU	25	
HANJIN HONG KONG	35	
HANJIN KEELUNG	22	9
HANJIN KOBE	33	20
HANJIN KUNSAN	32	
HANJIN KWANGYANG	42	
HANJIN LONG BEACH	25	
HANJIN MASAN	2	
HANJIN MOKPO	7	
HANJIN NEW YORK	22	
HANJIN SAVANNAH	51	8
HANJIN SEATTLE	19	3
HANJIN SEOUL	40	18
HANJIN YOKOHAMA	13	19
HANJIN YOSU	19	
HANSA CARRIER	18	
HANSA STAR	8	
HARMAC DAWN	69	
HAWAIIAN RAINBOW	56	42
HEIDELBERG EXPRESS	4	
HENRY HUDSON BRIDGE	192	
HERBERT C. JACKSON	42	
HESIOD	151	
HIRA #2	79	
HOEGH CAIRN	3	
HOEGH CLIPPER	1	
HOEGH DENE	6	
HOEGH DRAKE	14	27
HOEGH DUKE	25	
HOEGH DYKE	10	27
HOLIDAY	10	20
HOLSTEN CARRIER	54	
HONOLULU	194	
HOWELL LYKES	44	97
HUAL ANGELITA	9	77
HUDSON TRADER		62
HUMACAO	77	167
HUMBER ARM	5	
HYUNDAI #101	31	26
HYUNDAI CHALLENGER	27	8
HYUNDAI COMMANDER	15	11
HYUNDAI CONTINENTAL	44	
HYUNDAI ISLAND	46	
HYUNDAI NO. 109	13	
HYUNDAI PIONEER	23	17
HYUNDIA EXPLORER	34	27
IBIS ARROW	32	
INCOTRANS PACIFIC	75	
INDIAN OCEAN	4	97
INFANTA	124	
INGER	54	80
IRMA M	136	
IRVING L. CLYMER	65	80
ISLAND PRINCESS	121	
IST LT BALDOMERO LOPEZ	14	
ITAITE	23	
ITAPE	79	
ITB CHARLESTON	60	119
ITB PHILADELPHIA	148	198
J. BURTON AYERS	135	173
J.L. MAUTHE	17	32
JADRAN	3	
JADRAN EXPRESS	29	
JALAGOVIND	3	
JALISCO	71	67
JAMES LYKES	39	
JAPAN ALLIANCE	128	94
JAPAN APOLLO	85	71
JAPAN CARRYALL	57	
JEAN LYKES	55	75
JO BIRK	158	
JO CLIPPER	66	
JO CYPRESS	104	
JO GRAN	15	63
JO LONN	93	
JO OAK	90	
JOHN A. MCCONE		93
JOHN G. MUNSON	208	152
JOHN LYKES	48	
JOSEPH L. BLOCK	6	7
JOSEPH LYKES	35	46
JOVIAN LILY		115
JUGOAGENT		95
JULIUS HAMMER	42	58
JURAJ DALMATINAC	1	
KAIMOKU	45	85
KAINULA	24	64
KALIDAS	81	
KAUAI	55	159
KAYE E. BARKER	323	419
KEE LUNG	6	67
KEISHO MARU	54	
KENAI	57	88
KENNETH E. HILL	23	195
KENNETH T. DERR	28	60
KENTUCKY HIGHWAY	32	
KEYSTONE CANYON	12	18
KEYSTONER	54	163
KISO	129	
KOKUA	135	66
KOLN EXPRESS	148	
KOYAGI SPIRIT	40	
KUROBE	29	
LA MARQUESA	28	
LAKE CHARLES	3	
LAKE ERIE	29	
LARS MAERSK	44	128
LASH ATLANTICO	7	
LAURA MAERSK	32	68
LAWRENCE H. GIANELLA	45	69
LEDA MAERSK	30	60
LESLIE LYKES	19	75
LETITIA LYKES	31	
LEWIS WILSON FOY	282	408
LEXA MAERSK	7	18
LIBERTY STAR	25	58
LIBERTY SUN	116	80
LIBERTY WAVE	55	27
LILAS	15	26
LIRCAY	117	
LLOTD ITAJAI	30	
LLOYD SAO PAULO	74	
LNG AQUARIUS	50	178
LNG LEO	63	149
LNG TAURUS	6	191
LNG VIRGO	38	59
LONG LINES	39	
LOTUS ACE	91	
LOUISIANA	110	114
LOUISIANA BRIMSTONE	78	14
LT. ODYSSEY	63	157
LUNA MAERSK	8	16
LURLINE	78	171
LYRA	19	22
M. P. GRACE	9	
MAASSLOT	72	
MACKINAC BRIDGE	172	63
MAERSK COMMANDER	52	
MAERSK CONSTELLATION	58	154
MAERSK PINE	103	119
MAERSK SUN	58	
MAERSK TACOMA	2	
MAERSK TOKYO	36	
MAERSK WIND	1	
MAGALLANES	54	25
MAGIC	138	143
MAJ STEPHEN W PLESS MP	12	
MAJESTIC MAERSK	18	47
MALINI	28	
MALLORY LYKES	60	126
MANHATTAN BRIDGE	145	
MANUKAI	39	117
MANULANI	52	105
MAR TRANSPORTER II	153	144
MARATHA MAJESTY	21	
MARCHEN MAERSK	39	111
MAREN MAERSK	39	99
MARGARET LYKES	99	104
MARGRETHE MAERSK	37	102
MARIA TOPIC	32	144
MARIF	31	39
MARINE RELIANCE	8	24
MARIT MAERSK	12	115
MARITIME ASSOCIATE	36	
MARJORIE LYKES	27	42
MARLIN		232
MASON LYKES	47	104
MATHILDE MAERSK	10	
MATSONIA	50	171
MAUI	57	113
MAURICE EWING		11
MAYAGUEZ	34	18
MC KINNEY MAERSK	94	99
MEDALLION	164	136
MEDUSA CHALLENGER	115	164
MERCANDIAN CONTINENT	81	
MERCANDIAN SUN II	77	140
MERCURY ACE	55	
MERIDA	95	
MERKUR DELTA	138	55
MESABI MINER	57	76
METTE MAERSK	76	120
MICHIGAN HIGHWAY	46	
MICRONESIAN COMMERCE	7	12
MICRONESIAN INDEPENDEN	37	
MIDDLETOWN	74	153
MINDORO SAMPAGUITA	25	47
MING ENERGY	2	
MING MOON	22	85
MING OCEAN	23	46
MING PLENTY	12	17
MING PROMOTION	45	40
MING PROSPERITY	11	
MING SPRING	13	14
MING SUN	1	
MITLA	58	129
MOANA PACIFIC	117	82
MOBIL ARCTIC	9	149
MOBIL MERIDIAN	85	95
MOKU PAHU	148	116
MORELOS	70	
MORMACSKY	26	39
MORMACSTAR	71	141
MORMACSUN	51	122
MOSEL EXPRESS	56	
MSC CHIARA	22	
MSC SABRINA	23	3
MYRON C. TAYLOR	77	63
NACIONAL SANTOS	2	
NAMSAN SPIRIT	3	
NANCY LYKES	53	63
NARA	69	182
NATIONAL DIGNITY	34	149
NATIONAL HONOR	35	187
NATIONAL PRIDE	28	16
NAVIOS UNIQUE	33	
NEDLLOYD BAHRAIN	135	
NEDLLOYD BALTIMORE	62	
NEDLLOYD BANGKOK	130	
NEDLLOYD BARCELONA	51	
NEDLLOYD HOLLAND	58	158
NEDLLOYD HUDSON	82	150
NEDLLOYD KEMBLA	53	
NEDLLOYD KINGSTON	70	
NEDLLOYD KYOTO	127	
NEDLLOYD MANILA	129	
NEDLLOYD ROCHESTER	99	
NEDLLOYD ROTTERDAM	137	
NEDLLOYD ROUEN	87	
NEDLLOYD VAN CLOON	56	
NEPTUNE ACE	19	
NEPTUNE AMBER	102	254
NEPTUNE CORAL	56	
NEPTUNE CRYSTAL	66	93
NEPTUNE DIAMOND	180	
NEPTUNE GARNET	31	
NEPTUNE JADE	13	
NEPTUNE PEARL	74	150
NEPTUNE TOURMALINE	4	
NEW HORIZON	63	164
NEW LAPIS	17	19
NEW NOBLE	5	60
NEW RUBY	5	
NEW TOPAZ	23	
NEWARK BAY	69	116
NIGASAKI SPIRIT	82	137
NOAA DAVID STARR JORDA	86	96
NOAA SHIP CHAPMAN	243	351
NOAA SHIP DAVIDSON	36	50
NOAA SHIP DELAWARE II	274	
NOAA SHIP DISCOVERER O	211	27
NOAA SHIP FERREL	52	50
NOAA SHIP HECK 591	3	10
NOAA SHIP JOHN N COBB	2	22
NOAA SHIP M. BALDRIDGE	480	533
NOAA SHIP MCARTHUR	66	70
NOAA SHIP MILLER FREEM	211	188
NOAA SHIP MT MITCHEL	301	176
NOAA SHIP OREGON II	403	381
NOAA SHIP PEIRCE		23
NOAA SHIP RAINIER	240	
NOAA SHIP RUDE 590	11	28
NOAA SHIP SURVEYOR	38	
NOAA SHIP T. CROMWELL	303	
NOAA SHIP WHITING	184	210

Ship Name	radio	mail
NOBEL STAR	49	
NOMADIC LADY		33
NOSAC EXPLORER	32	6
NOSAC EXPRESS	59	85
NOSAC RANGER	57	70
NOSAC SKY	28	34
NOSAC SUN	14	
NOSAC TAKAYAMA	151	75
NOVA EUROPA	32	62
NUEVO SAN JUAN	76	158
NURNBERG EXPRESS	115	
OAXACA	100	
OCEAN BRIDGE	10	
OCEAN HIGHWAY	67	89
OCEAN LILY	5	
OCEAN LUCKY	26	
OCEAN MASTER	31	27
OCEAN SEL	32	52
OCEAN SPIRIT	64	
OGDEN WABASH	1	
OLEANDER	118	173
OLGA TOPIC	34	160
OMI CHAMPION	5	
OMI MISSOURI	77	54
OOCL DOMINANCE	81	
OOCL EDUCATOR	48	27
OOCL EXECUTIVE	94	61
OOCL FAIR	79	36
OOCL FAITH	13	
OOCL FORTUNE	32	
OOCL FRIENDSHIP	77	
ORANGE BLOSSOM		108
ORANGE STAR	69	48
ORCHID	44	169
ORCHID #2	33	10
OREGON RAINBOW II	59	105
ORIENTAL DIPLOMAT	11	
ORIENTAL EXPLORER	72	78
ORIENTAL FERM	64	
ORIENTAL FREEDOM	112	
ORIENTAL KNIGHT	5	
ORIENTAL PATRIOT	52	84
ORIENTE HOPE	12	17
ORION HIGHWAY	116	313
ORKANGER	74	151
OSPREY ARROW	96	
OVERSEAS ALICE	23	15
OVERSEAS ARCTIC	5	
OVERSEAS BOSTON		12
OVERSEAS CHICAGO	29	51
OVERSEAS HARRIET	31	106
OVERSEAS JOYCE	64	104
OVERSEAS JUNEAU		134
OVERSEAS MARILYN	62	91
OVERSEAS NEW ORLEANS	7	1
OVERSEAS NEW YORK	10	
OVERSEAS VALDEZ	59	96
OVERSEAS VIVIAN	34	31
PACDUCHESS	113	81
PACDUKE	39	
PACGLORY	15	10
PACIFIC ANGEL	8	
PACIFIC ARROW	87	101
PACIFIC EMERALD	21	22
PACIFIC PRINCESS	88	
PACIFIC SENTRY	3	13
PACKING	63	
PACMERCHANT	46	36
PACNOBLE	18	
PACOCEAN	11	
PACPRINCE	25	
PACPRINCESS	29	
PACSEA	39	
PACSTAR	35	27
PACSUN	11	
PAGA	58	118
PAPYRUS	14	45
PATRIOT	77	78
PAUL BUCK	64	93
PAUL H. TOWNSEND	8	
PAUL THAYER	1	
PECOS	17	16
PEGGY DOW	184	
PELANDER	148	219
PENNSYLVANIA TRADER	39	22
PERMEKE	4	
PERSEVERANCE	54	136
PETER W. ANDERSON	69	84
PETERSFIELD	55	
PFC EUGENE A. OBREGON	18	35
PFC JAMES ANDERSON JR	27	44
PFC WILLIAM B. BAUGH	107	32
PHAROS	53	
PHILIP R. CLARKE	133	94
PHILLIPS VENEZUELA	1	25
PINE FOREST	18	218
POCANTICO	27	
POLAR ALASKA	9	99
POLYNESIA	261	204
POMEROL	92	113
PONCE	24	38
POQUITA MAMI	3	
POTOMAC TRADER	93	73
PRESIDENT ADAMS	74	176
PRESIDENT ARTHUR	35	147
PRESIDENT BUCHANAN	10	
PRESIDENT EISENHOWER	135	202
PRESIDENT F. ROOSEVELT	69	148
PRESIDENT GARFIELD	22	
PRESIDENT GRANT	57	51
PRESIDENT HARDING	83	152
PRESIDENT HARRISON	124	
PRESIDENT HOOVER	82	163
PRESIDENT JACKSON	116	108
PRESIDENT JEFFERSON	32	76
PRESIDENT JOHNSON	3	
PRESIDENT KENNEDY	71	166
PRESIDENT LINCOLN	164	196
PRESIDENT MADISON	61	103
PRESIDENT MONROE	139	108
PRESIDENT POLK	140	198
PRESIDENT TRUMAN	121	124
PRESIDENT TYLER	45	74
PRESIDENT WASHINGTON	168	131
PRESIDENTE IBANEZ	1	9
PRESQUE ISLE	167	248
PRIMORJE	19	
PRINCE OF TOKYO	47	97
PRINCE OF TOKYO 2	107	176
PRINCE WILLIAM SOUND	56	114
PRINCESS DIAN		181
PROSPERO	18	
PUERTO CORTES	105	40
PURITAN	19	
PVT HARRY FISHER	1	
QUALITY OF LIFE	34	
QUEEN ELIZABETH 2	1	
RAINBOW BRIDGE	103	
RAINBOW HOPE	41	307
RALEIGH BAY	68	139
RANGER	68	
RANI PADMINI	80	46
RANIER	19	
RESERVE	81	146
RESOLUTE	18	115
RHINE FOREST	100	204
RICHARD G MATTIESEN	101	
RICHARD REISS	12	30
RIJEKA EXPRESS	5	
RIMBAS KEMPAS	34	37
RIO FRIO	133	
RIO LIMAY	11	
RIO NEGRO II	43	19
ROBERT E. LEE	18	31
ROGER BLOUGH	135	130
ROGER R. SIMONS	87	48
ROSETTA	92	
ROSINA TOPIC	26	44
ROTTERDAM	55	
ROVER	157	124
ROYAL PRINCESS	82	
ROYAL VIKING SKY	8	
RUTH LYKES	42	
S.T. CRAPO	118	166
SALINAS	30	140
SAM HOUSTON	24	
SAMUEL L. COBB	61	73
SAN LUIS	42	
SAN MARTIN	24	
SANKO PRELUDE	80	163
SANKO STORK	8	11
SANSINENA II	32	36
SANTA ADELA	47	44
SANTA JUANA	78	144
SANTA MARTA	3	
SANTA VICTORIA	26	29
SATURN DIAMOND	31	74
SAUDI ABHA	4	
SAUDI DIRIYAH	1	16
SAUDI MAKKAH	5	
SAUDI RIYADH	21	
SAVANNAH	85	
SCARAB	27	64
SEA BELLS	22	49
SEA COMMERCE	35	
SEA FAN	54	182
SEA FORTUNE	19	211
SEA FOX	67	73
SEA LANTERN		33
SEA LIGHT	31	119
SEA LION	83	43
SEA MERCHANT	282	254
SEA TRADE	127	
SEA WEALTH	5	
SEA WOLF	250	150
SEA-LAND ACHIEVER	70	156
SEA-LAND INTEGRITY	62	89
SEA-LAND VALUE	72	159
SEALAND ANCHORAGE	35	119
SEALAND ATLANTIC	51	122
SEALAND COMMITMENT	65	165
SEALAND CONSUMER	58	101
SEALAND CRUSADER	106	137
SEALAND DEFENDER	95	153
SEALAND DEVELOPER	46	89
SEALAND DISCOVERY	101	52
SEALAND ENDURANCE	52	73
SEALAND ENTERPRISE	184	166
SEALAND EXPEDITION	13	
SEALAND EXPLORER	61	144
SEALAND EXPRESS	89	205
SEALAND FREEDOM	92	
SEALAND INDEPENDENCE	60	
SEALAND INNOVATOR	47	
SEALAND KODIAK	28	78
SEALAND LIBERATOR	82	108
SEALAND MARINER	70	115
SEALAND NAVIGATOR	182	
SEALAND PACER	3	14
SEALAND PACIFIC	149	203
SEALAND PATRIOT	54	113
SEALAND PERFORMANCE	74	133
SEALAND PRODUCER	115	88
SEALAND QUALITY	75	158
SEALAND TACOMA	20	79
SEALAND TRADER	184	127
SEALAND VOYAGER	85	140
SEAWARD BAY	29	
SEDCO/BP 471	27	116
SENATOR	79	
SEVEN OCEAN	1	
SGT WILLIAM A BUTTON	43	12
SGT. METEJ KOCAK	27	19
SHELDON LYKES	84	156
SHELLY BAY	61	65
SHENAHON	41	42
SHIN BEISHU MARU	104	
SHINKASHU MARU	97	
SHIRAOI MARU	101	23
SHOSHONE SPIRIT	30	132
SILVER CLIPPER	48	12
SKANDERBORG	73	91
SKAUBORD	88	209
SKAUGRAN	62	123
SKEENA	125	
SKODBORG	24	42
SOARER CUPID	7	124
SOLAR WING	98	197
SONBAI	28	
SONORA	60	108
SOPHIA	45	
SOUTHLAND STAR	126	
SPAIN	55	69
SPARROWS POINT	1	
SPIRIT OF TEXAS		9
SPRING BEAR	194	
SPRING BEE	53	
SPRING SWIFT	12	
SPRING VEGA	19	115
STAR CANADIAN	19	40
STAR EAGLE	57	128
STAR EVVIVA	31	
STAR FLORIDA	90	
STAR FRASER	136	
STAR FUJI	30	
STAR GEIRANGER	14	11
STAR GRAN	42	108
STAR GRINDANGER	10	17
STAR HONG KONG	81	
STAR MERCHANT		40
STAR MERIT	22	54
STAR MINERVA	27	
STAR RANGER	35	76
STAR TRONDANGER NO	17	
STATE OF MAINE	48	88
STELLA LYKES	21	97
STEWART J. CORT	102	152
STONEWALL JACKSON	24	34
STRATHCONON	131	
STRIDER ISIS	180	144
STUTTGART EXPRESS	59	
SUE LYKES	14	
SUGAR ISLANDER	71	45
SUNBELT DIXIE	136	28
SUNWARD II	40	
SUSAK	2	
SWAN LAKE	33	83
SWIFT TRADER	15	
SWIFTNES	12	9
T.S.EMPIRE STATE	16	
TABASCO	99	184
TAI CORN	15	32
TALISMAN	1	
TAMPA	40	39
TARGET	44	29
TAYABAS BAY	26	116
TEMSE	3	
TEXACO MISSISSIPPI	2	
TEXACO NEW YORK	3	
TEXACO VERAGUAS	138	80
TEXACO WESTCHESTER	125	66
THOMAS WASHINGTON	126	240
THOMPSON LYKES	23	15
THOMPSON PASS		62
TIA SHENG	6	24
TOBA	37	
TOKYO HIGHWAY	1	

Ship Name	radio	mail
TOKYO MARU	31	
TOLUCA	70	76
TONCI TOPIC	26	39
TONSINA	18	32
TORRENS	30	
TRANSWORLD BRIDGE	38	16
TRIGGER	94	210
TRITON	175	219
TROPICAL BEAUTY		41
TROPICALE	24	36
TULSIDAS	24	
TUMILCO	174	47
ULTRAMAR	24	58
ULTRASEA	45	70
UNAMONTE	12	14
UNIVERSE	37	
URTE	29	107
USCGC ACACIA (WLB406)	22	72
USCGC ACTIVE WMEC 618	34	
USCGC ALERT (WMEC 630)	26	51
USCGC BASSWOOD (WLB 38	39	4
USCGC BISCAYNE BAY	10	
USCGC BRAMBLE (WLB 392	4	
USCGC BUTTONWOOD WLB 3	31	
USCGC CHEROKEE WMEC 16	58	
USCGC CHILULA (WMEC 15	22	
USCGC CITRUS (WMEC 300	215	
USCGC CONIFIR(WLB 301)	1	
USCGC DALLAS (WHEC 716	11	
USCGC DEPENDABLE	3	
USCGC DURABLE (WMEC 62	1	
USCGC EAGLE (WIX 327)	85	
USCGC ESCANABA	12	
USCGC EVERGREEN WMEC 2	37	
USCGC FIREBUSH WLB 393	8	
USCGC FORWARD	55	65
USCGC HAMILTON WHEC 71	14	
USCGC HARRIET LANE	1	
USCGC INDIAN HARBOR	25	69
USCGC JARVIS (WHEC 725	29	
USCGC KATMAI BAY	6	15
USCGC LAUREL (WLB 291)	13	
USCGC MACKINAW	15	4
USCGC MALLOW (WLB 396)	10	
USCGC MARIPOSA	16	25
USCGC MELLON (WHEC 717		86
USCGC MIDGETT (WHEC 72	31	
USCGC MOBIL BAY	3	7

Ship Name	radio	mail
USCGC MUNRO	3	
USCGC NEAH BAY	2	
USCGC NORTHLAND WMEC 9	45	
USCGC PLANETREE	6	
USCGC POLAR SEA WAGB 1	106	
USCGC POLAR STAR WAGB	88	92
USCGC RELIANCE WMEC 61	74	95
USCGC RESOLUTE WMEC 62	3	
USCGC SEDGE (WLB 402)	12	18
USCGC SPENCER	25	
USCGC STEADFAST WMEC 6	73	173
USCGC STORIS (WMEC 38)	1	86
USCGC SUNDEW (WLB 404)	11	36
USCGC SWEETBRIER WLB 4	20	
USCGC TAHOMA	48	
USCGC TAMAROA (WMEC 16	19	
USCGC TAMPA WMEC 902		123
USCGC THETIS	8	
USCGC VALIANT (WMEC 62	5	21
USCGC WOODRUSH (WLB 40	27	
USCGC YOCONA (WMEC 168	109	130
USNS ALTAIR	6	
USNS APACHE (T-ATF 172	47	125
USNS BARTLETT(T-AGOR 1	14	41
USNS CAPELLA	68	91
USNS CHAUVENET TAGS 29	34	109
USNS DE STEIGUER	3	9
USNS DENEBOLA	10	21
USNS GUS W. DARNELL	56	47
USNS HENRY J. KAISER		39
USNS JOHN LENTHAL		91
USNS KANE TAGS 27	9	
USNS LEROY GRUMMAN		46
USNS LYNCH T-AGOR 7	16	
USNS MAURY	33	
USNS MERCURY	1	175
USNS MISSISSINEWA		159
USNS MOHAWK (T-ATF 170	59	
USNS NARRAGANSETT	4	
USNS NAVAJO	17	26
USNS NAVISOTA		78
USNS PAWCATUCK TAO-108		217
USNS POWHATAN TATF 166	21	9
USNS RANGE SENTINEL	19	
USNS REGULUS	2	
USNS SATURN T-AFS-10		167
USNS SEALIFT ANTARCTIC	46	18
USNS SEALIFT ARABIAN S	19	
USNS SEALIFT ARCTIC	27	

Ship Name	radio	mail
USNS SEALIFT ATLANTIC	22	29
USNS SEALIFT CHINA SEA	76	168
USNS SEALIFT IND'N OCE	27	
USNS SEALIFT MED	23	10
USNS SEALIFT PACIFIC	36	44
USNS SIRIUS (T-AFS 8)		4
USNS SPICA (T-AFS 9)		71
USNS VANGUARD TAG 194	118	
USNS WILKES T-AGS-33	30	41
VALLEY FORGE	22	104
VAN TRADER	53	73
VIKING ACE	26	83
VISHVA PRAFULLA	1	
VISHVA SHAKTI	4	
WASHINGTON RAINBOW #2	25	89
WESTWARD VENTURE	148	268
WESTWOOD ANETTE	83	84
WESTWOOD BELINDA	18	23
WESTWOOD CLEO	112	41
WESTWOOD JAGO	118	46
WESTWOOD MARIANNE	25	94
WHITE ROSE	40	
WILFRED SYKES	34	115
WILLIAM E. MUSSMAN	19	14
WILLIAM J. DELANCEY	199	256
WINDWARD SENTRY	14	23
WOLVERINE	7	
WORLD TEXAS	40	
WORLD WING #2	31	
YAMATAKA MARU	69	
YANKEE CLIPPER	91	
YOUNG SCOPE	75	
YOUNG SPROUT	49	112
ZEELANDIA	43	
ZIM GENOVA	54	
ZIM HAIFA	37	
ZIM HONGKONG	51	
ZIM HOUSTON	26	
ZIM IBERIA	58	
ZIM KEELUNG	61	
ZIM MARSEILLES	32	
ZIM MIAMI	20	
ZIM MONTREAL	1	
ZIM NEW YORK	20	
ZIM SAVANNAH	32	
ZIM TOKYO	36	

Summary of U.S. VOS Weather Reports

Grand Total via Radio	55,212
Grand Total via Mail	54,986
Total Unique Obs.	85,668

Top Ships

Radio

Malcolm Baldridge
Kaye E. Barker

Mail

Malcolm Baldridge
Kaye E. Barker

April, May, and June 1990

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
A3BE	75	75	0	COLUMBUS CANADA
A3BZ	70	70	0	ACT 12
A8VI	46	46	0	PACDUCHESS
BNTB	2	2	0	R.V.14
CBVM	6	6	0	VINA DEL MAR
CGDV	81	81	0	W. TEMPLEMAN
CGXY	3	3	0	***
CG2676	8	8	0	SHAMOOK
CG2959	1	1	0	LEONARD J. COWLEY
CG2965	105	105	0	RICKER
CTHD	5	5	0	***
C6HL	83	83	0	LAZY JEAN
C7C	3	0	3	OCEAN STATION CHARLIE
DAKE	216	216	0	KOELN ATLANTIC
DA9100	263	263	0	NORDSEE
DESI	88	0	88	VALDIVIA
DGVK	38	38	0	COLUMBUS VICTORIA
DGZV	37	37	0	COLUMBUS VIRGINIA
DHCW	34	34	0	COLUMBUS WELLINGTON
DHOU	19	19	0	PURITAN
DLEZ	41	41	0	YANKEE CLIPPER
D5NE	12	12	0	MT CABRITE
D5NZ	103	103	0	POLYNESIA
EBHB	2	2	0	***
EKRB	4	4	0	TITANIT
ELBX3	30	30	0	PACKING
ELDM8	22	22	0	SEAL ISLAND
ELED7	37	37	0	PACPRINCE
ELED8	17	17	0	PACPRINCESS
ELEH4	19	19	0	C R POINTE NOIRE
ELHL6	48	48	0	COLUMBUS OHIO
ELJP6	5	5	0	CALIFORNIA HERMES
EREA	180	134	46	MUSSON
EREB	176	31	145	VOLNA
EREH	73	50	23	PRIBOY
EREI	96	4	92	OKEAN
ERES	199	133	66	VICTOR BUGAEN
ERET	77	76	1	GEORGE OUSHAKOV
EREU	161	159	2	ERNST KRENKEL
ESGG	43	2	41	VYACHESLAV FROLOV
ESGU	262	0	262	PERCY 3
FACU	1	1	0	DROGOU
FNCZ	71	71	0	LIBREVILLE
FNGB	52	52	0	MARION DUFRESNE
FNGS	65	65	0	LA FAYETTE
FNIB	20	20	0	THALASSA
FNOM	23	23	0	ANGO
FNPA	57	57	0	RONSARD
FNQB	44	44	0	ILE MAURICE
FNQD	43	43	0	ILE EDLA REUION
FNQM	42	42	0	VILLE DE MARSEILLE
FNZB	16	16	0	SAINT ROLAND
FNZO	93	93	0	RABELAIS
FNZP	79	79	0	RACINE
FNZQ	19	19	0	RIMBAUD
FPID	9	9	0	ROSPICO
FWQP	96	96	0	A. NIZERY
GACA	6	6	0	CUMULUS
GMZU	5	5	0	MINERVA
GPHH	10	10	0	FARNELLA
GQEK	61	61	0	FORTHBANK
GSXU	5	5	0	ANDROMEDA
GTIA	29	29	0	IVYBANK
GYSA	11	11	0	FLINDERS BAY
GYSE	36	36	0	NEDLLOYD TASMAN
GYSJ	12	12	0	***
GZKA	71	71	0	ACT 3
HO4667	36	36	0	***
HPAN	9	9	0	MICRONESIAN COMMERCE
HPEW	77	77	0	PACIFIC ISLANDER
H8CB	48	48	0	***
H9BQ	16	16	0	MICRONESIAN INDEPENDENCE
JBOA	74	74	0	KEIFU MARU
JBRR	27	27	0	JAPAN TUNA II
JCCX	174	174	0	CHOFU MARU
JCDF	77	77	0	SOYO MARU
JCDT	34	34	0	AMERICA MARU
JCIN	5	5	0	TOKYO MARU
JCOD	16	16	0	SHOYO
JDWX	104	104	0	KOFU MARU
JFDG	86	86	0	SHUMPU MARU
JGDW	61	61	0	KEITEN MARU
JGZK	112	112	0	RYOFU MARU
JITV	116	116	0	CANBERRA MARU
JJZC	37	37	0	HAKONE MARU
JLTI	4	4	0	SATSUNAN
JMSDF	20	20	0	CINCSDFLT JSMDF JA
JNVF	18	18	0	KAIYO MARU
JPVB	107	107	0	SEIFU MARU
JQNY	54	54	0	ZUIRYU MARU
JSVY	12	12	0	SHIRASE
KGWU	41	41	0	TH. WASHINGTON
KIRH	87	87	0	SEA-LAND TRADER
KNBD	32	32	0	DELAWARE II
KRGB	86	86	0	SEA-LAND ENTERPRISE
KVWA	24	24	0	TEXAS CLIPPER
LYEF	4	4	0	***
LYKN	1	1	0	***
LYKO	8	8	0	***
NAEE	6	6	0	DE STEIGUER
NAVOCE	6	6	0	U.S. NAVAL OCEANOGRAPHIC
NAWR	18	18	0	ARTHUR RADFORD
NBTM	10	10	0	POLAR STAR
NBXW	2	2	0	***
NDIT	1	1	0	MELLON
NEKF	6	6	0	LYNCH
NFKQ	9	9	0	SEALIFT ARABIAN SEA
NGDF	4	4	0	MUNRO
NHDB	7	7	0	TRUETT
NIDK	11	11	0	ICEPAT GROTON CT
NLGF	6	6	0	NORTHLAND
NLOH	1	1	0	PREBLE
NMEL	74	74	0	MELLON
NQST	45	45	0	SEALIFT ARCTIC
NRAR	10	10	0	MONTEREY
NRCB	22	22	0	EAGLE
NRP	5	5	0	***
NRUO	62	62	0	POLAR SEA
NSBL	1	1	0	***
NSBR	1	1	0	SAMUEL ROBERTS
NTRI	4	4	0	WILKES
NYGG	60	60	0	CHAUVENET
ONE	3	3	0	OCEANOUNIT ONE
OWEQ2	41	41	0	MCKINNEY MAERSK
OWUO6	107	107	0	MOANA PACIFIC COBENHAVN
OXMD2	48	48	0	LARS MAERSK
PGDG	41	41	0	NEDLLOYD KINGSTON
PGDI	41	41	0	NEDLLOYD MANILA
PGDS	46	46	0	NEDLLOYD KYOTO
PGDT	39	39	0	NEDLLOYD BALTIMORE
PGDV	18	18	0	NEDLLOYD BANGKOK
PGEH	25	25	0	NEDLLOYD BAHRAIN
PGEM	26	26	0	NEDLLOYD BARCELONA
PJYG	175	175	0	OLEANDER
PWAN	7	7	0	***
PWSA	10	10	0	***
SCRIPP	1	1	0	SCRIPPSINST
SHIP	658	658	0	***
S6FK	54	54	0	SWAN REEFER
TESTP	2	2	0	PACIFIC TEST
TFEA	34	34	0	BJARNI SAEMUNDSSON
UEAK	53	2	51	VALERIAN URYVAYEV
UHQS	24	0	24	AKADEMIK KOROLEV
UINF	80	76	4	GLADIMIR PARSHIN
UJFO	126	126	0	MULTANOVSKIY PROF
UKYW	3	3	0	***
UMAY	47	1	46	AKADEMIK SHIRSHOV
UMFW	38	38	0	PROF. ZUBOV
UMWZ	3	3	0	MIRNY
UQHM	111	10	101	ABAKANLES
UUNS	1	1	0	***
UUPB	15	2	13	AKADEMIK N. SHOKALSKIY
UUQR	5	5	0	MOLCHANOV PAVEL PRO
UUVN	3	3	0	LENSK
UVMJ	1	1	0	VSEVOLOD BERYOZKIN
UVMM	141	132	9	GAKKEL, YAKOV
UWEC	33	1	32	PROFESSOR KHROMOV
UWFD	1	1	0	***
UZGH	21	16	5	PASSAT
VCBT	3	3	0	CAPE ROGER
VCTF	18	18	0	CAPE BRIER
VC9616	51	51	0	LADY HAMMOND
VKCN	58	58	0	CANBERRA
VKCV	44	44	0	DERWENT
VKLA	173	173	0	ADELAIDE
VKLC	7	7	0	BRISBANE
VKML	29	29	0	SYDNEY
VKMN	10	10	0	PARRAMATTA
VKMS	83	83	0	COOK
VKPM	6	6	0	MORESBY
VKPT	9	9	0	PERTH
VP17	65	65	0	AIRCRAFT SQUADRON
VP67	4	4	0	AIRCRAFT SQUADRON
WCGN	7	7	0	CHEVRON CALIFORNIA
WKWB	7	7	0	***
WRBA	6	6	0	PACMISRANFAC HAWAREA

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
WRBB	9	9	0	***
WSD3628	23	23	0	ROYAL DAWN
WSQ267	5	5	0	ROBERT GORDEN SPROUL
WTDF	4	4	0	T. CROMWELL
WTDK	2	2	0	D.S. JORDAN
WTDM	49	49	0	M.FREEMAN
WTDO	107	107	0	OREGON II
WTEA	25	25	0	DISCOVERER
WTED	84	84	0	CHAPMAN
WTEF	7	7	0	RAINIER
WTEG	15	15	0	MOUNT MITCHELL
WTEJ	1	1	0	MCARTHUR
WTEK	3	3	0	DAVIDSON
WTER	166	166	0	M. BALDRIDGE
WTES	29	29	0	SURVEYOR
WTEW	8	8	0	WHITING
WUW9647	4	4	0	BARBRA H.
WXBR	47	47	0	CHEVRON MISSISSIPPI
WYR4481	1	1	0	W.J. DELANCY
ZCKP	14	14	0	STAR HONGKONG
ZCSK	63	63	0	SKEENA
ZCSL	32	32	0	NIMOS

CALL SIGN	TOTAL	BATHY	TESAC	SHIP NAME
3EAJ	62	62	0	POTOI ISLAND
3EET4	54	54	0	SEAS EIFFEL
3EET6	4	4	0	***
3SVY	1	1	0	***
7JOB	36	36	0	SHIN KASHU MARU
7KDD	35	35	0	YOKO MARU
32317B	4	4	0	BUOY
32318B	2	2	0	BUOY
51006B	1	1	0	BUOY
51007B	1	1	0	BUOY
51008B	1	1	0	BUOY
51009B	1	1	0	BUOY
51010B	10	10	0	BUOY
51011B	3	3	0	BUOY
51012B	1	1	0	BUOY
52002B	4	4	0	BUOY
52003B	11	11	0	BUOY
52006B	4	4	0	BUOY
52301B	14	14	0	BUOY
52302B	11	11	0	BUOY

TOTAL BATHYS RECEIVED 8310
TOTAL TESACS RECEIVED 1054
TOTAL REPORTS RECEIVED 9364

It is illegal for any vessel to dump plastic trash anywhere in the ocean or navigable waters of the United States. Annex V of the MARPOL TREATY is a new International Law for a cleaner, safer marine environment. Each violation of these requirements may result in civil penalty up to $25,000, a fine up to $50,000, and imprisonment up to 5 years.

WORKING TOGETHER, WE CAN ALL MAKE A DIFFERENCE!

CENTER FOR MARINE CONSERVATION 1725 DeSales Street, NW Washington, DC 20036 (202) 429-5609

April, May, and June 1990

Wave observations are taken each hour during a 20–minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one–third of the waves during the hourly averaging period. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0–minute averaging period each hour (moored buoys) and a 2.0–minute averaging period for fixed stations (C–MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688–2838 for more details.

	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KN)	PREV WIND (DIR)	MAX WIND (KN)	MAX WIND (DA/HR)	MEAN PRESS (MB)
APRIL 1990													
BUOY													
32302	18.0S	085.1W	0702	20.9	21.4	1.9	3.6	01/01	11.7	SE	19.2	29/23	1015.5
41001	34.9N	073.0W	0704	18.2	20.9	1.9	5.7	11/21	14.1	S	33.6	11/20	1018.3
41002	32.3N	075.2W	0710	20.1	22.2	1.6	3.9	11/22	12.4	NE	24.6	18/11	1018.5
41006	29.3N	077.4W	0707	21.5	23.3	1.6	3.8	19/16	10.6	E	24.5	19/15	1018.5
41008	30.7N	081.1W	0393	20.2	20.1	1.0	3.0	19/00	8.8	S	26.4	18/22	1018.5
41009	28.5N	080.2W	1378	22.2	23.6	1.3	3.3	19/23	11.6	E	23.9	19/19	1018.0
41010	28.9N	078.5W	1410	21.8	23.4	1.4	3.8	19/20	12.0	E	27.0	03/11	1019.3
42001	25.9N	089.7W	0709	22.7	23.2	1.0	2.7	07/21	11.5	SE	26.2	27/16	1016.5
42002	26.0N	093.5W	0699	22.2	22.7	1.2	2.9	07/11	15.0	SE	30.9	27/11	1015.8
42003	25.9N	085.9W	0706	23.8	25.7	1.1	2.7	20/17	12.5	E	29.7	01/01	1017.5
42007	30.1N	088.8W	0709	19.3	20.8	0.6	1.7	27/19	12.4	SE	29.5	07/02	1018.8
42015	30.2N	088.2W	0709	19.0	20.0	0.6	2.2	28/02	10.2	SE	28.6	07/10	1018.5
42016	30.2N	088.1W	0709	19.1	20.1	0.6	2.2	28/01	10.1	SE	26.0	07/10	1017.8
44004	38.5N	070.6W	0709	11.1	11.8	1.7	6.4	11/16	11.4	NW	30.1	05/04	1017.9
44005	42.7N	068.6W	0614	5.3	5.1	1.7	3.9	11/14	13.3	SW	26.6	11/09	1016.6
44007	43.5N	070.1W	0707	4.9	3.8	1.1	2.5	05/08	11.6	S	28.8	11/10	1015.4
44008	40.5N	069.5W	0708	6.7	6.1	1.5	5.6	12/00	12.8	SW	31.3	07/18	1017.9
44009	38.5N	074.6W	0709	10.0	9.1	0.9	2.5	11/07	11.8	S	29.7	11/03	1018.5
44011	41.1N	066.6W	0707	6.2	5.6	2.0	6.1	12/08	11.3	S	27.8	07/21	1017.4
44013	42.4N	070.8W	0710	7.0	5.1	0.8	3.0	04/03	12.7	SW	33.6	11/08	1016.9
45001	48.0N	087.7W	0358	2.4	0.9	0.8	3.0	17/08	11.2	S	30.5	28/02	1011.8
45004	47.5N	086.5W	0379	3.8	1.6	0.7	3.3	17/09	11.0	S	23.5	17/15	1012.1
45006	47.3N	089.9W	0345	3.3	1.0	0.7	2.5	28/01	10.5	SW	22.9	17/03	1011.3
45007	42.7N	087.1W	0125	7.4	3.5	0.3	0.6	28/14	8.9	S	15.5	28/19	1008.5
46003	51.9N	155.9W	0708	4.0	4.1	2.9	6.2	03/07	14.4	W	31.1	28/22	1008.4
46005	46.1N	131.0W	0714	9.1	9.5	2.2	4.4	10/10	11.2	NW	23.0	09/15	1018.7
46006	40.8N	137.7W	0711	11.9	12.1	2.3	5.9	09/13	14.5	SW	29.3	08/14	1018.9
46010	46.2N	124.2W	0713	9.9	10.8	1.8	4.0	26/08	10.3	N	30.7	25/10	1018.0
46011	34.9N	120.9W	0714	12.9	13.1	2.0	4.9	25/07	11.7	NW	27.5	30/03	1016.2
46013	38.2N	123.3W	0710	11.3	10.8	1.9	4.1	29/04	13.8	NW	34.7	30/01	1016.3
46014	39.2N	124.0W	0712	11.2	11.1	1.9	3.9	30/03	11.0	NW	30.3	30/01	1017.4
46022	40.8N	124.5W	0239	10.8	11.2	1.8	4.3	30/06	8.9	N	26.2	30/03	1018.9
46025	33.7N	119.1W	0715	15.1	16.0	1.2	2.9	24/07	6.9	NW	29.2	24/06	1015.4
46026	37.8N	122.7W	0712	11.6	11.8	1.5	3.2	25/04	12.8	NW	33.4	24/02	1016.5
46027	41.8N	124.4W	0702	10.1	10.5	1.8	3.1	24/06	9.5	N	32.6	30/02	1018.4
46028	35.8N	121.9W	0715	12.4		2.2	4.7	25/06	13.7	N	30.6	24/21	1016.7
46030	40.4N	124.5W	0455	10.7	10.7	1.7	4.1	30/04	13.2	N	24.5	22/20	1017.8
46035	57.0N	177.7W	0711	0.4		1.7	7.2	01/20	14.6	NE	37.1	01/09	1018.6
46040	44.8N	124.3W	0477	10.1	10.6	1.8	3.3	22/19	11.0	N	18.8	03/03	1018.4
46041	47.4N	124.5W	0714	9.3	10.1	1.7	4.5	26/03	8.7	NW	23.3	28/09	1017.7
46042	36.8N	122.4W	0713	12.0	12.4	2.0	4.6	25/09	12.3	NW	29.5	30/03	1017.9
51001	23.4N	162.3W	0711	22.4	23.6	2.0	4.6	08/03	11.8	NE	21.9	27/10	1017.3
51002	17.2N	157.8W	0712	24.3	25.0	2.1	3.3	21/14	13.3	E	23.8	22/12	1015.2
51003	19.2N	160.8W	0302	24.4	25.2	1.9	2.3	28/04	9.3	E	18.5	21/06	1014.8
51004	17.5N	152.6W	0710	23.8	24.8	2.1	3.2	22/11	13.8	E	21.6	21/02	1015.8
C-MAN													
ALSN6	40.5N	073.8W	0709	8.9	7.8	0.9	2.3	03/15	15.8	SW	41.3	11/04	1017.4
BURL1	28.9N	089.4W	0713	19.2					11.8	E	28.3	07/09	1017.0
BUZM3	41.4N	071.0W	0703	6.9					15.7	S	40.1	11/08	1017.1
CARO3	43.3N	124.4W	0712	10.1					8.7	N	36.5	22/18	1019.2
CHLV2	36.9N	075.7W	0711	12.8	11.7	0.9	2.0	07/10	13.0	S	35.2	17/23	1019.0
CLKN7	34.6N	076.5W	0706	16.9					10.8	SW	26.5	18/07	1019.1
CSBF1	29.7N	085.4W	0714	19.8					7.4	SE	25.3	28/06	1018.8
DBLN6	42.5N	079.4W	0710	8.0					10.8	SW	31.9	04/21	1016.9
DESW1	47.7N	124.5W	0713	9.4					10.0	NW	30.2	28/01	1016.0
DISW3	47.1N	090.7W	0707	3.1					12.1	SW	31.0	02/01	1015.1
DPIA1	30.3N	088.1W	0709	19.0	20.2				10.9	SE	31.6	07/10	1018.7
DSLN7	35.2N	075.3W	0709	17.4	21.4	1.4	3.7	18/09	15.4	W	39.6	11/13	1018.8
ENIP2	11.4N	162.4E	0709	27.4					14.0	E	20.8	16/10	1009.8
FARP2	8.6N	144.6E	0463	27.9					8.1	E	17.9	10/14	1010.1
FBIS1	32.7N	079.9W	0709	18.1					9.9	SW	28.9	18/13	1018.9
FFIA2	57.3N	133.6W	0712	6.5					8.5	N	40.2	08/09	1017.5
FPSN7	33.5N	077.6W	0709	18.7					15.6	SW	37.4	11/11	1019.2
GBCL1	27.8N	093.1W	0714	20.8	22.7				14.9	SE	30.4	27/11	1016.8
GDIL1	29.3N	090.0W	0711	20.2					11.1	E	27.2	07/09	1017.7
GLLN6	43.9N	076.4W	0707	5.5					12.1	W	31.0	17/16	1015.7
IOSN3	43.0N	070.6W	0712	6.4					14.1	S	34.4	04/07	1017.1
LKWF1	26.6N	080.0W	0706	22.9	24.7				12.3	E	26.5	20/04	1017.5
MDRM1	44.0N	068.1W	0706	4.0					14.5	SW	36.1	11/09	1016.3
MISM1	43.8N	068.9W	0709	4.2					15.0	SW	40.1	11/09	1016.5
MLRF1	25.0N	080.4W	0708	23.9	25.3				12.2	E	37.1	03/17	1017.7
MPCL1	29.4N	088.6W	0713	19.7	20.7								1017.6
NWPO3	44.6N	124.1W	0714	9.9					8.3	N	29.0	22/17	1018.1

	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KN)	PREV WIND (DIR)	MAX WIND (KN)	MAX WIND (DA/HR)	MEAN PRESS (MB)
PILM4	48.2N	088.4W	0706	1.0					12.4	NW	34.5	19/23	1014.9
PTAC1	39.0N	123.7W	0715	10.8					9.4	N	25.8	29/22	1017.7
PTAT2	27.8N	097.1W	0695	21.1	21.9				14.1	SE	27.7	29/21	1014.5
PTGC1	34.6N	120.7W	0715	12.7					13.7	N	34.8	24/08	1016.5
ROAM4	47.9N	089.3W	0700	1.2					14.8	SW	39.4	02/03	1013.9
SAUF1	29.9N	081.3W	0696	19.5	20.4				10.2	SE	29.8	18/22	1018.5
SBIO1	41.6N	082.8W	0707	8.8					12.4	SW	33.7	17/07	
SGNW3	43.8N	087.7W	0707	5.2					11.2	S	30.5	02/14	1015.8
SISW1	48.3N	122.8W	0714	9.2					7.2	W	30.0	24/07	1017.8
SMKF1	24.6N	081.1W	0710	24.3	25.1				12.6	E	30.3	03/17	1016.8
SPGF1	26.7N	079.0W	0708	23.1	25.1				9.2	E	27.6	20/00	1017.3
SRST2	29.7N	094.1W	0675	19.7					13.0	SE	32.4	27/07	1017.7
STDM4	47.2N	087.2W	0709	3.0					16.2	S	39.1	15/13	1014.3
SVLS1	32.0N	080.7W	0710	18.2	17.9				13.6	S	40.0	18/14	1018.7
TPLM2	38.9N	076.4W	0707	12.0	11.2				11.1	S	28.4	04/17	1017.5
TTIW1	48.4N	124.7W	0714	8.7					10.1	S	31.0	10/15	1018.0
UJAP2	8.9N	165.7E	0705	27.8					13.4	E	25.7	21/03	1008.7
VENF1	27.1N	082.5W	0713	21.2	23.4				8.8	E	24.3	03/20	1017.3
WPOW1	47.7N	122.4W	0692	10.1					7.1	S	21.6	23/05	1016.8
MAY		**1990**											
BUOY													
32302	18.0S	085.1W	0052	20.2	21.1	1.8	2.2	01/11	12.5	SE	19.2	01/04	1015.4
41001	34.9N	073.0W	0739	21.1	22.3	1.8	4.8	11/05	14.0	SW	31.3	06/08	1015.8
41002	32.3N	075.2W	0742	22.6	23.7	1.4	4.0	23/11	10.6	S	24.8	23/11	1016.7
41006	29.3N	077.4W	0741	24.1	24.6	1.2	2.4	24/02	9.6	SW	22.2	11/11	1016.9
41008	30.7N	081.1W	0737	23.4	23.6	0.8	1.9	10/06	9.7	S	23.3	22/02	1016.3
41009	28.5N	080.2W	1475	24.7	24.6	0.8	1.6	10/10	10.6	SE	19.6	09/11	1016.3
41010	28.9N	078.5W	1475	24.6	25.3	1.1	2.0	07/14	11.2	S	24.9	10/18	1017.7
42001	25.9N	089.7W	0741	26.0	26.1	0.9	1.8	03/13	10.3	SE	21.0	03/10	1013.8
42002	26.0N	093.5W	0741	25.6	26.1	1.2	3.2	03/14	13.2	SE	29.1	03/08	1012.7
42003	25.9N	085.9W	0736	26.1	26.8	0.9	2.4	26/17	10.8	SE	20.8	21/06	1017.5
42007	30.1N	088.8W	0739	23.9	25.3	0.5	1.8	09/08	12.4	SE	28.2	13/16	1015.9
42015	30.2N	088.2W	0738	23.5	24.5	0.6	1.8	09/07	10.2	SE	25.1	13/17	1015.6
42016	30.2N	088.1W	0481	23.4	24.2	0.7	1.5	09/04	10.9	SE	26.0	13/17	1015.9
42019	27.9N	095.0W	0163	27.1	27.1	1.0	1.6	30/15	11.4	SE	17.9	30/11	1009.4
42020	27.0N	096.5W	0175	27.3	27.1	1.1	1.8	31/18	12.9	SE	18.1	31/17	1008.1
44004	38.5N	070.6W	0741	13.1	12.3	1.7	5.8	11/07	10.2	N	28.6	30/09	1014.3
44005	42.7N	068.6W	0633	8.0	7.2	1.5	4.4	05/18	11.1	S	30.5	11/08	1013.3
44007	43.5N	070.1W	0741	8.5	7.0	1.0	3.5	05/22	10.9	S	31.3	11/05	1013.6
44008	40.5N	069.5W	0738	9.9	8.7	1.5	5.0	11/12	12.8	SW	34.0	11/06	1014.2
44009	38.5N	074.6W	0736	14.7	13.6	1.0	2.9	11/00	12.1	S	31.9	10/20	1014.9
44011	41.1N	066.6W	0741	9.0	7.7	1.9	4.8	11/20	10.7	N	29.1	30/20	1013.3
44013	42.4N	070.8W	0738	10.5	8.7	0.8	2.4	06/02	11.2	S	28.0	11/04	1013.9
45001	48.0N	087.7W	0739	3.0	1.7	0.7	3.0	10/17	8.8	NE	28.8	10/15	1014.9
45002	45.3N	086.4W	0169	7.7	3.3	0.3	0.9	29/07	9.5	NE	18.9	28/21	1017.7
45003	45.3N	082.7W	0739	4.6	2.3				7.8	NW	25.8	11/11	1014.3
45004	47.5N	086.5W	0740	4.2	2.3	0.8	3.8	10/18	9.9	N	28.3	10/18	1014.4
45005	41.7N	082.4W	0603	12.4	11.8	0.6	2.4	10/19	10.4	SW	30.9	11/03	1012.9
45006	47.3N	089.9W	0742	3.5	1.9	0.7	3.1	08/07	9.1	NE	27.8	08/04	1014.6
45007	42.7N	087.1W	0737	6.5	4.4	0.6	3.7	10/16	8.9	N	32.8	10/13	1013.5
45008	44.3N	082.4W	0736	5.4	3.0	0.4	0.8	01/05	8.2	NE	25.4	11/07	1015.2
46003	51.9N	155.9W	0733	5.4	5.3	2.4	4.9	19/02	13.1	S	26.4	17/18	1010.3
46005	46.1N	131.0W	0418	10.0	10.7	2.1	4.2	30/25	12.4	NW	23.4	05/14	1021.5
46006	40.8N	137.7W	0732	12.2	13.3	2.1	6.5	30/03	13.6	NE	30.1	30/08	1020.7
46010	46.2N	124.2W	0732	10.8	11.5	1.8	3.7	22/09	10.8	NW	31.5	20/05	1016.4
46011	34.9N	120.9W	0732	12.5	12.5	1.8	3.5	08/04	10.0	NW	23.0	25/01	1015.8
46013	38.2N	123.3W	0732	11.1	10.4	2.1	4.6	31/15	15.3	NW	31.3	07/04	1014.1
46014	39.2N	124.0W	0730	11.2	10.9	2.4	5.3	07/01	14.4	NW	29.0	07/08	1014.9
46022	40.8N	124.5W	0245	10.7	10.2	2.4	5.5	07/03	12.1	N	29.1	08/00	1016.1
46023	34.3N	120.7W	0126	13.2	12.5	1.9	4.1	31/23	10.6	NW	16.4	31/23	1014.1
46025	33.7N	119.1W	0743	15.4	17.4	1.1	2.7	29/03	7.8	NW	24.0	29/00	1014.6
46026	37.8N	122.7W	0731	11.4	11.5	1.6	3.0	31/18	12.6	W	28.6	14/22	1014.9
46027	41.8N	124.4W	0724	9.9	9.0	2.2	4.0	06/16	15.2	N	33.6	06/23	1015.4
46028	35.8N	121.9W	0741	12.7		2.2	4.2	07/22	12.0	NW	26.0	07/04	1015.9
46030	40.4N	124.5W	0731	10.4	9.5	2.2	4.7	07/10	13.1	N	30.3	20/00	1015.6
46035	57.0N	177.7W	0733	2.9		1.8	4.4	04/23	12.3	SE	29.9	10/17	1001.7
46040	44.8N	124.3W	0682	11.0	11.4	2.1	4.5	31/08	11.2	S	27.2	20/02	1016.4
46041	47.4N	124.5W	0734	10.2	10.8	1.7	3.9	06/19	9.2	NW	25.1	22/01	1016.1
46042	36.8N	122.4W	0734	12.0	12.3	1.9	4.5	31/23	11.5	NW	23.1	06/21	1016.7
51001	23.4N	162.3W	0739	22.7	23.4	2.2	3.8	04/07	14.8	E	25.0	04/06	1020.1
51002	17.2N	157.8W	0736	24.8	25.4	2.2	3.5	04/22	15.0	E	20.5	18/05	1015.9
51003	19.2N	160.8W	0740	24.6	25.5	2.2	3.6	04/08	13.7	NE	23.2	04/02	1016.6
51004	17.5N	152.6W	0737	24.3	25.0	2.2	4.0	06/06	14.7	NE	21.6	17/17	1016.1
C-MAN													
ALSN6	40.5N	073.8W	0738	13.5	12.4	0.9	2.8	21/06	14.8	SW	34.8	10/21	1014.1
BURL1	28.9N	089.4W	0740	23.9					11.4	SE	35.2	28/19	1014.1
BUZM3	41.4N	071.0W	0740	11.0					14.2	SW	37.7	11/03	1013.7
CARO3	43.3N	124.4W	0741	10.8					10.5	N	28.9	29/22	1017.2
CHLV2	36.9N	075.7W	0739	17.3	16.2	0.9	2.5	22/06	13.8	S	29.7	10/19	1015.8
CLKN7	34.6N	076.5W	0740	21.1					11.3	SW	29.4	23/01	1016.4
CSBF1	29.7N	085.4W	0740	23.8					7.3	SE	19.1	10/23	1016.2
DBLN6	42.5N	079.4W	0741	11.5					11.5	SW	40.3	11/08	1014.4
DESW1	47.7N	124.5W	0741	10.5					10.2	NW	33.7	22/04	1015.9
DISW3	47.1N	090.7W	0741	6.0					11.4	NE	33.2	08/01	1015.5
DPIA1	30.3N	088.1W	0741	23.5	25.2				11.0	SE	33.0	13/16	1015.2
DSLN7	35.2N	075.3W	0737	20.8	22.5	1.3	4.3	23/06	16.8	SW	42.3	10/18	1016.1
ENIP2	11.4N	162.4E	0731	27.7					15.5	E	27.0	09/19	1009.7
FARP2	8.6N	144.6E	0454	28.0					8.1	E	21.1	07/13	1009.7
FBIS1	32.7N	079.9W	0739	22.8					9.7	SW	24.7	10/11	1016.2

	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KN)	PREV WIND (DIR)	MAX WIND (KN)	MAX WIND (DA/HR)	MEAN PRESS (MB)
FFIA2	57.3N	133.6W	0743	9.4					5.5	N	30.5	03/22	1015.2
FPSN7	33.5N	077.6W	0737	22.1					14.0	S	36.3	23/00	1016.6
GBCL1	27.8N	093.1W	0736	24.7	25.9				14.5	SE	32.8	08/19	1013.5
GDIL1	29.3N	090.0W	0741	24.9					11.0	SE	26.2	28/18	1014.6
GLLN6	43.9N	076.4W	0739	9.3					10.4	SW	39.9	11/14	1013.9
IOSN3	43.0N	070.6W	0742	9.8					13.3	S	33.3	05/22	1014.2
LKWF1	26.6N	080.0W	0739	25.2	26.2				11.1	SE	21.5	13/03	1016.2
MDRM1	44.0N	068.1W	0742	6.8					13.8	SW	44.1	05/16	1013.2
MISM1	43.8N	068.9W	0741	7.2					13.8	SW	41.1	11/07	1013.5
MLRF1	25.0N	080.4W	0739	25.8	26.7				11.8	SE	28.4	25/23	1016.5
MPCL1	29.4N	088.6W	0731	23.9	24.8				11.9	SE	31.6	13/21	1014.9
NWPO3	44.6N	124.1W	0742	10.6					8.3	N	27.0	22/01	1016.4
PILM4	48.2N	088.4W	0739	4.6					10.7	NE	31.8	08/04	1015.9
PTAC1	39.0N	123.7W	0738	10.8					11.1	N	24.7	22/19	1015.3
PTAT2	27.8N	097.1W	0742	24.8	25.9				14.2	SE	34.8	12/08	1011.0
PTGC1	34.6N	120.7W	0658	12.3					14.9	N	29.3	06/15	1015.1
ROAM4	47.9N	089.3W	0713	4.3					13.5	NE	39.5	08/04	1014.8
SAUF1	29.9N	081.3W	0741	23.8	25.2				10.6	SE	25.8	09/23	1016.1
SBIO1	41.6N	082.8W	0738	13.4					11.0	E	43.1	11/04	1012.3
SGNW3	43.8N	087.7W	0740	8.7					11.3	N	33.1	10/08	1014.2
SISW1	48.3N	122.8W	0742	10.5					8.4	W	32.0	05/21	1015.9
SMKF1	24.6N	081.1W	0742	26.2	26.7				12.9	E	34.3	26/00	1015.5
SPGF1	26.7N	079.0W	0742	25.4	26.8				6.3	SE	19.3	09/05	1016.1
SRST2	29.7N	094.1W	0741	24.4					13.7	SE	29.0	12/05	1013.8
STDM4	47.2N	087.2W	0740	5.1					13.5	E	41.1	10/17	1015.0
SVLS1	32.0N	080.7W	0741	22.0					12.3	S	30.0	22/03	1015.8
TPLM2	38.9N	076.4W	0742	16.6	16.8				10.6	S	32.6	18/20	1014.2
TTIW1	48.4N	124.7W	0742	9.8					9.1	S	28.0	20/19	1016.4
UJAP2	8.9N	165.7E	0736	27.6					14.4	E	25.2	11/00	1008.7
VENF1	27.1N	082.5W	0690	24.9	27.4				8.4	E	22.0	22/19	1015.7
WPOW1	47.7N	122.4W	0727	11.5					6.9	S	20.0	05/21	1015.2
JUNE		**1990**											
BUOY													
41001	34.9N	073.0W	0718	22.9	23.7	1.6	4.7	13/03	12.4	SW	29.0	12/20	1016.4
41002	32.3N	075.2W	0718	24.4		1.4	4.1	13/08	10.4	SW	23.4	13/03	1017.2
41006	29.3N	077.4W	0714	26.1	26.9	1.2	3.5	13/20	9.3	SW	21.2	25/12	1017.7
41008	30.7N	081.1W	0719	25.8	26.2	0.7	1.6	14/00	8.6	SW	19.6	23/11	1017.1
41009	28.5N	080.2W	1433	26.6	27.4	0.7	1.9	14/04	8.2	SE	22.3	22/23	1017.4
41010	28.9N	078.5W	1433	26.3	26.8	1.0	2.6	14/00	8.8	S	25.3	23/02	1016.3
42001	25.9N	089.7W	0718	27.7	28.6	0.6	1.9	01/18	8.7	SE	26.8	08/21	1016.3
42002	26.0N	093.5W	0716	28.0	29.2	0.8	2.2	30/03	10.0	SE	24.5	30/02	1015.7
42003	25.9N	085.9W	0715	27.7	28.7	0.6	1.8	13/22	7.2	E	22.0	23/21	1016.6
42007	30.1N	088.8W	0718	28.0	29.4	0.4	0.8	01/00	9.2	S	22.9	04/04	1017.3
42015	30.2N	088.2W	0715	27.7	28.7	0.4	1.1	04/06	7.8	SW	21.0	22/16	1017.1
42019	27.9N	095.0W	0715	28.3	29.0	0.9	2.8	02/10	10.0	SE	23.7	02/08	1015.2
42020	27.0N	096.5W	0715	28.1	28.5	1.1	2.7	02/13	12.4	SE	28.0	30/21	1014.0
44004	38.5N	070.6W	0717	18.5	17.5	1.4	4.1	12/23	11.4	N	30.5	12/21	1015.2
44005	42.7N	068.6W	0671	12.5	11.2	1.2	2.9	11/19	9.5	SW	24.7	04/00	1013.5
44007	43.5N	070.1W	0716	13.0	11.3	0.8	2.0	04/01	9.6	S	28.8	04/00	1013.1
44008	40.5N	069.5W	0716	14.2	11.3	1.2	2.8	12/14	11.4	SW	28.6	04/09	1015.0
44009	38.5N	074.6W	0712	19.4	18.6	0.9	2.2	12/07	10.6	S	26.0	10/03	1015.8
44011	41.1N	066.6W	0718	14.1	12.0	1.5	3.8	05/00	8.1	SW	23.5	12/17	1014.3
44013	42.4N	070.8W	0712	16.1	13.5	0.5	2.0	12/17	10.0	SW	29.1	11/14	1013.6
45001	48.0N	087.7W	0719	5.0	2.7	0.5	2.8	03/15	8.3	SE	27.6	03/15	1010.7
45002	45.3N	086.4W	0719	10.2	6.3				10.7	SW	21.8	12/13	1012.0
45003	45.3N	082.7W	0718	7.4	3.7				8.0	S	15.8	04/06	1012.3
45004	47.5N	086.5W	0718	6.4	3.2				10.6	SE	21.5	04/00	1010.5
45005	41.7N	082.4W	0718	18.3	17.7	0.5	2.0	03/23	9.5	SW	28.2	03/06	1013.4
45006	47.3N	089.9W	0716	6.2	3.0	0.4	2.0	03/15	7.5	W	23.3	03/14	1010.3
45007	42.7N	087.1W	0713	12.0	9.2	0.5	2.2	23/11	8.4	SW	23.9	03/20	1012.6
45008	44.3N	082.4W	0715	10.4	7.2	0.5	2.1	04/12	8.2	S	19.0	24/01	1013.6
46002	42.5N	130.4W	0167	14.2	14.6	1.4	2.1	24/01	9.8	SW	17.7	29/08	1016.9
46003	51.9N	155.9W	0712	7.0	7.1	2.1	5.1	14/10	13.4	W	27.8	13/16	1013.0
46005	46.1N	131.0W	0238	12.1	12.4	2.0	3.8	04/12	11.7	NW	21.3	06/21	1018.1
46006	40.8N	137.7W	0714	13.3	14.0	1.8	5.2	03/19	12.1	NW	26.2	03/17	1021.9
46010	46.2N	124.2W	0715	13.0	13.7	1.7	3.0	05/04	11.7	N	27.6	21/03	1017.7
46011	34.9N	120.9W	0713	13.0	12.4	2.0	4.2	05/17	13.0	NW	24.8	04/21	1014.8
46012	37.4N	122.7W	0228	13.2	12.9	1.3	1.9	24/12	9.2	NW	17.0	28/06	1015.8
46013	38.2N	123.3W	0715	12.4	10.8	2.0	4.0	13/06	16.4	NW	32.9	13/04	1015.1
46014	39.2N	124.0W	0716	12.6	11.5	1.9	3.8	05/06	10.3	NW	27.0	13/01	1016.6
46022	40.8N	124.5W	0237	13.0	12.7	2.0	4.3	14/06	8.9	N	22.1	13/21	1018.1
46023	34.3N	120.7W	0713	13.2	13.0	2.2	4.2	01/04	17.6	NW	28.1	28/12	1013.4
46025	33.7N	119.1W	0713	17.2	18.8	1.2	2.4	01/07	6.3	NW	19.8	01/00	1013.3
46026	37.8N	122.7W	0715	12.2	11.9	1.5	3.3	13/09	13.1	W	29.0	12/02	1015.6
46027	41.8N	124.4W	0697	12.0	11.8	1.7	3.6	01/05	10.5	N	30.9	13/23	1017.3
46028	35.8N	121.9W	0715	13.7		2.4	4.4	05/14	17.5	NW	29.4	13/00	1015.5
46030	40.4N	124.5W	0716	12.5	11.4	1.8	4.0	01/08	11.4	N	22.3	13/22	1017.3
46035	57.0N	177.7W	0713	5.1		1.0	2.7	21/08	9.7	SW	23.3	21/07	1012.5
46040	44.8N	124.3W	0714	13.0	13.4	1.8	3.6	01/02	11.3	N	23.7	21/05	1018.2
46041	47.4N	124.5W	0713	12.5	13.3	1.7	3.0	03/03	9.9	NW	25.6	03/03	1017.3
46042	36.8N	122.4W	0713	13.0	12.6	2.1	4.5	13/08	13.6	NW	24.1	13/00	1017.2
51001	23.4N	162.3W	0716	24.5	24.8	2.1	3.6	17/11	14.3	E	23.0	27/00	1019.0
51002	17.2N	157.8W	0166	25.3	25.9	2.6	3.2	03/18	17.3	E	20.5	04/07	1016.0
51003	19.2N	160.8W	0715	25.4	26.1	2.0	2.9	22/03	12.9	NE	19.6	19/15	1015.5
51004	17.5N	152.6W	0713	24.7	25.4	2.4	3.7	20/23	16.7	E	34.8	15/08	1016.1
C-MAN													
ALSN6	40.5N	073.8W	0713	19.0	16.9	0.8	2.8	25/15	12.7	S	35.1	06/19	1014.4
BURL1	28.9N	089.4W	0714	27.3					7.9	SE	21.8	02/07	1015.9
BUZM3	41.4N	071.0W	0713	16.0					12.8	SW	32.9	11/23	1014.0

	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KN)	PREV WIND (DIR)	MAX WIND (KN)	MAX WIND (DA/HR)	MEAN PRESS (MB)
CARO3	43.3N	124.4W	0716	12.7					9.4	N	26.0	02/22	1018.6
CHLV2	36.9N	075.7W	0713	21.4	20.9	0.8	2.1	12/08	11.3	S	28.0	22/21	1016.8
CLKN7	34.6N	076.5W	0712	24.3					10.4	SW	23.4	12/13	1017.3
CSBF1	29.7N	085.4W	0715	27.1					6.9	W	22.5	23/16	1017.3
DBLN6	42.5N	079.4W	0713	17.9					9.9	SW	28.4	19/21	1013.9
DESW1	47.7N	124.5W	0715	12.5					10.9	NW	28.3	03/03	1015.2
DISW3	47.1N	090.7W	0709	13.0					9.6	SW	24.0	18/06	1011.0
DPIA1	30.3N	088.1W	0713	27.7	29.3				7.7	SW	22.7	23/07	1016.6
DSLN7	35.2N	075.3W	0713	23.5	24.7	1.2	3.3	13/00	13.8	SW	32.2	23/22	1016.9
ENIP2	11.4N	162.4E	0704	27.8					12.4	E	23.9	19/07	1009.6
FARP2	8.6N	144.6E	0406	27.6					10.2	E	30.3	21/19	1009.3
FBIS1	32.7N	079.9W	0710	26.0					10.2	SW	24.0	16/21	1016.8
FFIA2	57.3N	133.6W	0712	11.7					6.7	S	21.0	09/07	1014.5
FPSN7	33.5N	077.6W	0713	24.9					12.5	SW	26.7	23/15	1017.2
GBCL1	27.8N	093.1W	0715	27.4	29.0	0.7	1.7	30/09	9.9	SE	29.8	02/09	1016.3
GDIL1	29.3N	090.0W	0713	28.5					7.5	SE	27.0	23/11	1016.4
GLLN6	43.9N	076.4W	0659	15.2					10.3	S	50.3	18/13	1012.3
IOSN3	43.0N	070.6W	0713	15.4					12.5	S	32.0	03/22	1013.8
LKWF1	26.6N	080.0W	0713	26.8	27.5				8.4	SE	26.9	24/19	1017.4
MDRM1	44.0N	068.1W	0713	10.7					12.4	SW	32.0	04/01	1013.2
MISM1	43.8N	068.9W	0712	11.2					12.6	SW	32.0	04/01	1013.3
MLRF1	25.0N	080.4W	0714	27.5	28.7				8.9	SE	22.8	22/05	1017.8
MPCL1	29.4N	088.6W	0535	27.6	29.4				8.9	SW	19.9	04/06	1016.6
NWPO3	44.6N	124.1W	0714	12.6					8.5	N	26.0	21/01	1017.5
PILM4	48.2N	088.4W	0713	7.1					10.5	SW	26.2	12/09	1011.5
PTAC1	39.0N	123.7W	0716	11.9					9.4	N	25.0	21/20	1016.9
PTAT2	27.8N	097.1W	0714	27.9	29.2				14.3	SE	30.2	02/08	1013.9
PTGC1	34.6N	120.7W	0715	12.9					17.6	N	28.4	25/00	1014.4
ROAM4	47.9N	089.3W	0671	7.4					12.1	NE	40.4	03/15	1010.3
SAUF1	29.9N	081.3W	0713	25.0	25.1				7.2	SW	22.1	04/20	1017.2
SBIO1	41.6N	082.8W	0714	19.6					12.1	SW	42.8	03/22	1012.8
SGNW3	43.8N	087.7W	0712	15.2					10.8	S	33.5	03/14	1012.1
SISW1	48.3N	122.8W	0712	12.1					8.5	W	24.0	11/17	1017.1
SMKF1	24.6N	081.1W	0714	28.0	28.6				9.1	E	24.9	08/02	1017.2
SPGF1	26.7N	079.0W	0712	27.1	28.7				4.8	S	16.1	22/20	1017.2
SRST2	29.7N	094.1W	0716	28.2					11.2	S	27.7	27/19	1016.3
STDM4	47.2N	087.2W	0711	9.7					16.0	S	38.1	03/18	1011.1
CLKN7	34.6N	076.5W	0712	24.3					10.4	SW	23.4	12/13	1017.3
CSBF1	29.7N	085.4W	0715	27.1					6.9	W	22.5	23/16	1017.3
DBLN6	42.5N	079.4W	0713	17.9					9.9	SW	28.4	19/21	1013.9
DESW1	47.7N	124.5W	0715	12.5					10.9	NW	28.3	03/03	1015.2
DISW3	47.1N	090.7W	0709	13.0					9.6	SW	24.0	18/06	1011.0
DPIA1	30.3N	088.1W	0713	27.7	29.3				7.7	SW	22.7	23/07	1016.6
DSLN7	35.2N	075.3W	0713	23.5	24.7	1.2	3.3	13/00	13.8	SW	32.2	23/22	1016.9
ENIP2	11.4N	162.4E	0704	27.8					12.4	E	23.9	19/07	1009.6
FARP2	8.6N	144.6E	0406	27.6					10.2	E	30.3	21/19	1009.3
FBIS1	32.7N	079.9W	0710	26.0					10.2	SW	24.0	16/21	1016.8
FFIA2	57.3N	133.6W	0712	11.7					6.7	S	21.0	09/07	1014.5
FPSN7	33.5N	077.6W	0713	24.9					12.5	SW	26.7	23/15	1017.2
GBCL1	27.8N	093.1W	0715	27.4	29.0	0.7	1.7	30/09	9.9	SE	29.8	02/09	1016.3
GDIL1	29.3N	090.0W	0713	28.5					7.5	SE	27.0	23/11	1016.4
GLLN6	43.9N	076.4W	0659	15.2					10.3	S	50.3	18/13	1012.3
IOSN3	43.0N	070.6W	0713	15.4					12.5	S	32.0	03/22	1013.8
LKWF1	26.6N	080.0W	0713	26.8	27.5				8.4	SE	26.9	24/19	1017.4
MDRM1	44.0N	068.1W	0713	10.7					12.4	SW	32.0	04/01	1013.2
MISM1	43.8N	068.9W	0712	11.2					12.6	SW	32.0	04/01	1013.3
MLRF1	25.0N	080.4W	0714	27.5	28.7				8.9	SE	22.8	22/05	1017.8
MPCL1	29.4N	088.6W	0535	27.6	29.4				8.9	SW	19.9	04/06	1016.6
NWPO3	44.6N	124.1W	0714	12.6					8.5	N	26.0	21/01	1017.5
PILM4	48.2N	088.4W	0713	7.1					10.5	SW	26.2	12/09	1011.5
PTAC1	39.0N	123.7W	0716	11.9					9.4	N	25.0	21/20	1016.9
PTAT2	27.8N	097.1W	0714	27.9	29.2				14.3	SE	30.2	02/08	1013.9
PTGC1	34.6N	120.7W	0715	12.9					17.6	N	28.4	25/00	1014.4
ROAM4	47.9N	089.3W	0671	7.4					12.1	NE	40.4	03/15	1010.3
SAUF1	29.9N	081.3W	0713	25.0	25.1				7.2	SW	22.1	04/20	1017.2
SBIO1	41.6N	082.8W	0714	19.6					12.1	SW	42.8	03/22	1012.8
SGNW3	43.8N	087.7W	0712	15.2					10.8	S	33.5	03/14	1012.1
SISW1	48.3N	122.8W	0712	12.1					8.5	W	24.0	11/17	1017.1
SMKF1	24.6N	081.1W	0714	28.0	28.6				9.1	E	24.9	08/02	1017.2
SPGF1	26.7N	079.0W	0712	27.1	28.7				4.8	S	16.1	22/20	1017.2
SRST2	29.7N	094.1W	0716	28.2					11.2	S	27.7	27/19	1016.3
STDM4	47.2N	087.2W	0711	9.7					16.0	S	38.1	03/18	1011.1
TPLM2	38.9N	076.4W	0714	22.0	21.8				9.9	S	32.3	12/01	1014.9
TTIW1	48.4N	124.7W	0714	11.9					9.1	S	26.0	01/00	1017.6
UJAP2	8.9N	165.7E	0709	27.7					10.9	E	26.9	18/18	1008.7
VENF1	27.1N	082.5W	0432	26.7	30.1				6.9	E	16.8	23/21	1016.7
WPOW1	47.7N	122.4W	0675	13.8					7.3	S	22.1	04/10	1016.2

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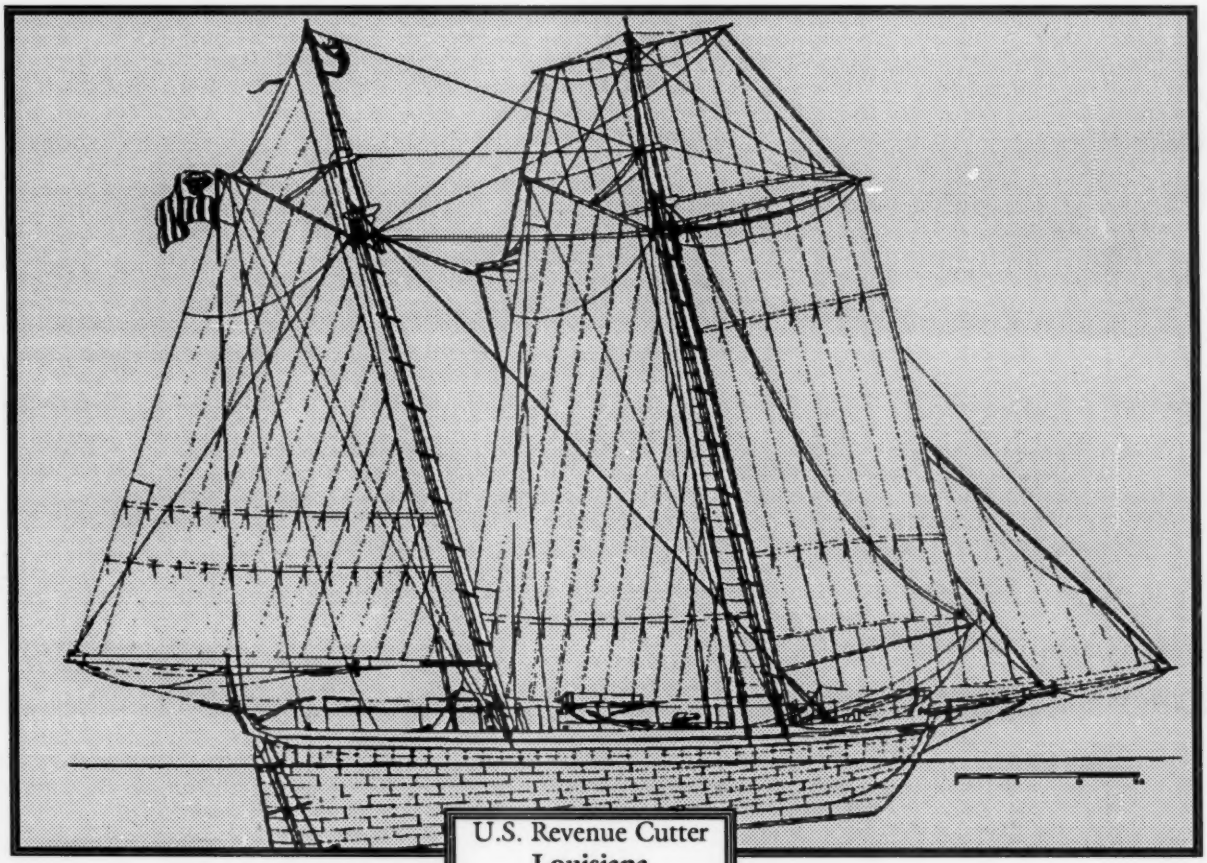

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